Issued October 8, 1913.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE GEOLOGICAL SURVEY OF NEW JERSEY, HENRY B. KUMMEL, STATE GEOLOGIST; NEW JERSEY AGRICULTURAL EXPERIMENT STATION, JACOB G. LIPMAN, DIRECTOR.

SOIL SURVEY OF THE SUSSEX AREA, NEW JERSEY

BY

H. JENNINGS, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND I. L. OWEN, I. V. STONE, AND W. R. ROBBERS, OF THE NEW JERSEY AGRICULTURAL EXPERIMENT STATION.

J. E. LAPHAM, INSPECTOR IN CHARGE NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1911.]

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1913.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., February 12, 1913.

SIR: The bureau is cooperating with the New Jersey Geological Survey in the survey and classification of the soils of New Jersey. The accompanying report and map cover the work in the Sussex area during the field season of 1911. In selecting this section of the State for survey at this time the bureau was guided by the agricultural importance of the territory tributary to the large cities of New York and Philadelphia and by the varied soil conditions, a knowledge of which had become necessary to the work of correlating the soils of the eastern seaboard States. The selection was made after conference with the state officials cooperating.

I have the honor to transmit herewith the manuscript report and map covering this area, and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1911, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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SOIL SURVEY OF THE SUSSEX AREA, NEW JERSEY.

By H. JENNINGS, of the U. S. Department of Agriculture, and I. L. OWEN, I. V. STONE, and W. R. ROBBERS, of the New Jersey Agricultural Experiment Station.

DESCRIPTION OF THE AREA.

The Sussex area is situated in the extreme northern part of the State of New Jersey. It is bounded on the west and northwest by the Delaware River, and for a distance of 22 miles on the northeastern border by Orange County, N. Y. Its greatest length from north to south is 29 miles and from east to west 42 miles. Practically all of Sussex County, the northern part of Warren County, the western section of Passaic County, and a portion of northern Morris County are included in the area, which covers 788 square miles, or 504,320 acres.

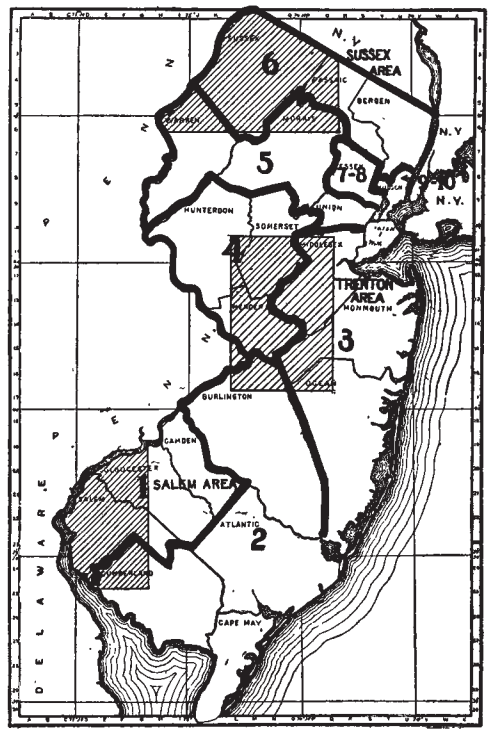

FIG. 1.—Sketch map showing areas surveyed in New Jersey.

The Sussex area has five conspicuous physiographic divisions. The Delaware River, with its comparatively wide terraces, gives rise to a district which, though of relatively small extent, embraces some of the best trucking soils in the area. The Kittatinny Mountain, forming a part of the well-known Blue Ridge of the Appalachian Mountain system, traverses the area in a northeasterly and southwesterly direction. This ridge has a relatively even crest and approximately the same elevation throughout its entire length. The eastern slope is very steep—almost precipitous in some places—the western slope being much less abrupt. From the north the ridge continues in a southerly or

southwesterly direction, passing out of the State at Delaware Water Gap. The section of the area west of Beemerville is about 7 miles wide, gradually narrowing to the north in the direction of Port Jervis. The Kittatinny Mountain has an extreme elevation of 1,809 feet at High Point and, with few low areas, it extends as a very high ridge throughout the whole of its course. It is marked by one low depression, known as "Culvers Gap." This is a wind gap and the only natural pass in Sussex County.

West of the Kittatinny Mountain a steep, narrow ridge, known as "Wallpack Ridge," extends northeast from Flatbrookville to the State line and separates the main valley of the Delaware River from the depression drained by its tributaries, Flat Brook and Clove Brook.

The Kittatinny Valley extends in a northeast and southwest direction east of the mountain of the same name. It varies from 10 to 13 miles in width. On the east the valley is bordered by the Highlands. The altitude of the eastern part of the valley is from 300 to 600 feet lower than that portion next to the Kittatinny Mountain. With this difference in elevation and the rolling nature of the country included between the higher elevations on both the east and west, this part of the area, called "valley land," is characterized by considerable topographic relief and differs from the more level valley lands or bottom lands to which this term is often applied. There are a number of rolling hills and ridges running through the valley which have the same general direction as the main valley and as the mountains on the east and west. The topographic features of the surface depend largely on the underlying rock formations, which offer varying degrees of resistance to weathering, depending on their lithologic character and on the activity of erosive agencies. These various features make a very great difference in the agricultural value of the several sections in the area. Agriculturally this valley is the most important section of the area.

Southeast of Kittatinny Valley is the elevated belt of country known as the Highlands of New Jersey, the southwestward continuation of the Highlands of the Hudson. It occupies nearly one-half of the area described in this report, and although interrupted by several large valleys it can be regarded as a unit. Viewed as a whole, the Highlands may be considered as a dissected plateau, having an average elevation in this region of 1,100 to 1,300 feet, above which rise rounded knobs to a maximum elevation of 1,496 feet and below which the streams have eroded valleys of varying width and depth. Two of these, Vernon Valley, extending northeast from Hamburg to the State line, and the upper Wallkill Valley, stretching 10 miles southwest from Franklin Furnace, can be regarded as branches of

Kittatinny Valley which penetrate the western margin of the Highlands and are separated from the main valley by semi-isolated mountain masses. Both of these valleys are narrow, not exceeding 2 miles in width, and of the two, Vernon Valley is most important agriculturally.

More important than these as structural features is the great valley extending southwest from Greenwood Lake to Newfoundland, Oak Ridge, and far beyond the limits of the area. It is remarkable for its continuity and for the absence of a continuous stream. At the north it drains northward into Greenwood Lake. Another section drains southwest into Pequannock River, which crosses it almost at right angles, while the southwestern section, known as Longwood Valley, is drained to the southwest by the headwaters of Rockaway River. In the vicinity of Newfoundland and Oak Ridge the valley widens greatly and was at one time a section of considerable agricultural importance. Adjoining this valley are steep-sided, even-crested ridges resembling in structure Kittatinny Mountain and known as Green Pond, Copperas, Kanouse, and Bearfort Mountains. These mountains differ from the Highlands east and west of them in that they are steep-sided ridges extending northeast and southwest for miles without interruption. Both they and the Greenwood Lake-Longwood Valley are due to a belt of limestone, shale, sandstone, and conglomerate in the midst of the crystalline rocks which underlie most of the Highlands.

Pequannock River, the master stream of this section, crosses the Highlands to the southeast, at right angles to the general structure, in a narrow, steep depression, which for much of the distance is merely a rocky gorge, along the sides of which there is barely room for a railroad and highway. East of Newfoundland it crosses the Copperas-Kanouse Ridge through a gap comparable to the Delaware Water Gap through Kittatinny Mountain.

In addition to those mentioned, many small streams which dissect the Highlands have developed small valleys, most of which, however, are not of great importance agriculturally.

The fifth physiographic province represented is in the extreme southeast, where a small portion of the Triassic, or red shale, lowland is included in the region studied. Its elevation is about 180 feet and its area 2 square miles. Farther south this province develops into a broad, rolling lowland of excellent agricultural possibilities.

The area is drained by tributaries of three river systems, the Delaware, Hudson, and Passaic. The Delaware drains that part of the area west of the Kittatinny Mountain, through Big and Little Flatbrook, which unite and flow into the river at Flatbrookville. West of the Wallpack Ridge drainage waters find their way direct to the Delaware River. Paulins Kill drains the southwestern part of the

Kittatinny Valley, while the southeastern part is drained by the headwaters of the Pequest River. Both of these streams flow in a southwesterly direction and empty into the Delaware outside the present area.

The northern and eastern portion of Kittatinny Valley, including its branches, Sparta and Vernon Valleys, are drained by Wallkill River and its tributaries, and are parts of the Hudson River drainage basin.

The eastern part of the Highlands is drained by two tributaries of the Passaic River, which head in Sussex County and feed the Rockaway and Pequannock Rivers. There are other minor streams which enter the area, draining small areas, and finally uniting with the Passaic River beyond the boundaries of the present survey.

There are frequent swamps and low meadows bordering many of the streams. In the Wallkill Basin this feature is especially pronounced and can be accounted for by the slight fall of the stream. Above Sussex a stretch of this low land is encountered, having a fall of about 20 feet in 6 miles. In the Paulins Kill Basin there are several large tracts of level land which are subject to excessive moisture during the late fall, winter, and spring. This condition can be accounted for by the blocking of the original drainageways by glacial deposits.

The area is well supplied with natural lakes and ponds, of which Hopatcong, Culvers, Greenwood, Swartswood, and Macopin are the more important. Numerous others of smaller size are found throughout the area and attract many city visitors during the vacation period.

In the upper part of the Pequannock drainage basin three large reservoirs, at Clinton, Oak Ridge, and Canistear, have been constructed as a water supply for the city of Newark, and large tracts of land adjoining these reservoirs or tributary to them have been purchased and are being reforested to prevent pollution and maintain an adequate water supply.

The settlement of Sussex County commenced about 1680, though the exact place and date are not definitely known. At the present time the whole county is settled, the Kittatinny Valley being the more thickly populated, while the Highlands and Delaware Valleys are most sparsely settled. The present population is made up principally of the descendants of the original settlers. In the mines at Franklin Furnace there are a number of Poles, Hungarians, and Italians. These are for the most part a transient class, and so are scarcely to be considered from an agricultural standpoint. Satisfactory labor is difficult to secure on the farms, as the manufacturing industries offer better pay with shorter hours.

Newton, the county seat of Sussex and the largest town in the area, is situated in the south-central part of the county and has a population of 4,467 according to the census of 1910. It is also the principal manufacturing town of the area, having large shoe factories and silk mills. Butler, with a population of 2,265, is the second town in importance. Hard and soft rubber products are its important industries. The towns of Sussex (Deckertown), Blairstown, Franklin Furnace, Hamburg, Branchville, Ogdensburg, Andover, Sparta, Marksboro, and Vernon are of similar size, named in order of importance. Franklin Furnace is noted for its famous zinc mines. Numerous other hamlets occur throughout the area.

The transportation facilities of the area are exceptionally good. The Sussex branch of the Delaware, Lackawanna & Western Railroad furnishes direct connection with New York. At Branchville Junction this line divides, one terminal being located at Franklin Furnace and the other at Branchville. The same railroad has recently completed a cut-off from Delaware Water Gap to Lake Hopatcong, which traverses the southern portion of the area and gives direct communication with New York. Another direct rail line to New York is the New York, Susquehanna & Western. This has two branches, the main line passing from Butler to Beaver Lake, and thence in a southwesterly direction, passing out of the area through the Delaware Water Gap. The Middletown branch of this road runs from Beaver Lake through Sussex and passes out of Sussex County near Unionville. The Lehigh & Hudson River Railway traverses the area in a northeast-southwest direction. This is the main connecting line between Easton and Newburgh, also connecting with the main line of the Erie system. The Lehigh & New England Railroad enters Sussex County near the point where the Wallkill River leaves it and connects at Swartswood Junction with the New York, Susquehanna & Western. The Ogden Mine Railroad, a branch of the Central Railroad of New Jersey, connects Edison, in the Highland district, with Dover. The Wharton & Northern Railroad also traverses the Highlands, connecting the mining district in the southern part of the area with the main lines to the south.

Farm products meet with ready sale in the towns of the area and adjoining sections, though the principal market for the area is New York City. Milk and veal are sent principally to New York and other near-by cities, while the fruit crop, such as apples, goes mostly to Philadelphia. Peaches are sold locally.

CLIMATE.

The climate of northern New Jersey is moderately cold in winter and generally cool in summer. The periods of minimum tempera-

tures very seldom exceed three days' duration, and weather below zero is exceptional, although temperatures of −30° F. have been recorded. The maximum temperature recorded is 101° F. The hot spells, however, are usually tempered by breezes, and the nights are cool. The Sussex area is considered one of the most healthful sections of the State.

There are four Weather Bureau stations in this area, situated at Sussex and Newton, in the Kittatinny Valley, at Layton, west of Kittatinny Mountain, and at Charlotteburg, in the eastern Highlands. There is considerable variation in the rainfall and temperature of these sections, Layton and Charlotteburg having a temperature from 1 to 3 degrees cooler than the stations in the Kittatinny Valley. Another very striking difference in the reports of these four stations is the great variation in the dates of the first and the last killing frosts. At Layton the growing season—the period free from killing frosts—for a period of 10 years has an average length of 137 days; at Charlotteburg, 146 days; at Sussex, 161 days; and at Newton, 171 days. The differences indicated are sufficiently pronounced to be considered in the planting of such crops as corn and other tender plants.

In winter the ground freezes to a considerable depth. At times when thaws occur, during particularly cold seasons, grains and new seedings of clover and other legumes are likely to "heave" and winterkill. In many instances this results in heavy damage. In the spring fruit buds are often injured by late frosts. This can be avoided to some extent by care in selecting sites with favorable air drainage and exposure. Northwest slopes are several days later than the southeastern exposures.

The precipitation, as a rule, is evenly distributed throughout the entire year, though there are occasional seasons when some damage is caused by drought. This is most noticeable on the lighter soils, especially the lighter members of the Hoosic, Dutchess, and Chenango series. From 3 to 4 inches of rainfall may be expected monthly throughout the entire growing season. Droughty conditions have marked the past three seasons, and have, naturally, reduced the crop yields. More careful consideration should be given to the preservation of the water supply in soils with a tendency to drought. The annual snowfall of the area is moderate, the mean being 3 feet.

Following are tables showing the difference in precipitation at the four stations named, also dates of the first and last killing frosts, with the length of the season for a period of years.

Total precipitation at Layton, Sussex, Newton, and Charlotteburg during a period of 11 years.

Year.	Layton, elevation 550 feet.	Sussex, elevation 442 feet.	Newton, elevation 678 feet.	Charlotteburg, elevation 719 feet.	Year.	Layton, elevation 550 feet.	Sussex, elevation 442 feet.	Newton, elevation 678 feet.	Charlotteburg, elevation 719 feet.
	Inches.	*Inches.*	*Inches.*	*Inches.*		*Inches.*	*Inches.*	*Inches.*	*Inches.*
1899	.....	44.60	46.74	50.07	1905	39.02	37.91	50.47	43.21
1900	.....	36.11	38.45	45.86	1906	43.77	43.65	48.62	49.82
1901	49.84	51.52	54.07	66.82	1907	44.49	45.56	.....	56.19
1902	47.00	56.47	61.00	60.41	1908	34.70	34.94	40.14	47.80
1903	53.96	58.79	59.09	65.95	1909	35.56	40.15	41.13	47.86
1904	35.00	41.57	44.88	46.40	1910	34.56	.....	.....	41.36

Normal monthly and annual temperature and precipitation.

Month.	Sussex.		Layton.		Newton.		Charlotteburg.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	°*F.*	*Inches.*	°*F.*	*Inches.*	°*F.*	*Inches.*	°*F.*	*Inches.*
January	26.1	3.61	24	3.50	25.7	3.50	27.1	3.98
February	26.2	3.54	24.1	3.46	26.7	3.83	25.4	4.48
March	36.4	3.67	34.2	3.67	35.8	3.60	36.1	4.35
April	48.3	3.25	46.5	3.21	47.6	3.21	46.5	3.87
May	58.5	3.91	57.9	3.33	56.3	4.14	57.5	4.80
June	67.6	3.73	66.3	3.42	67.7	3.79	65.3	4.26
July	71.7	4.52	70.2	4.43	71.9	4.70	70.1	4.88
August	69.6	4.32	68.4	3.64	69.8	4.41	67.9	4.75
September	63.9	3.91	61.8	3.87	63.6	.....	62.4	4.68
October	52.2	3.35	49.6	3.33	.....	.....	52.9	4.41
November	[1] 41	3.12	38	3.08	39.5	2.95	40.3	3.73
December	[1] 29.7	3.74	28.4	4.13	29.4	3.69	30	4.39
Annual	.....	.....	47.4	43.21	.....	.....	48.3	52.58

[1] Averages up to and for the year 1909.

Dates of the first and the last killing frosts and the length of the season between them.

Year.	Sussex, elevation 442 feet.			Layton, elevation 550 feet.		
	Last in spring.	First in fall.	Length of season.	Last in spring.	First in fall.	Length of season.
1900	May 11	Oct. 17	159	.....	Sept. 19	.....
1901	May 6	Oct. 7	155	May 6	Sept. 26	144
1902	Apr. 20	Oct. 10	174	May 29	Oct. 10	135
1903	May 2	Sept. 30	151	May 12	Sept. 25	136
1904	Apr. 23	Sept. 22	152	May 3	Sept. 22	142
1905	May 2	Oct. 22	163	May 24	Sept. 27	126
1906	May 11	Oct. 13	155	May 11	Oct. 12	154
1907	May 12	...do	154	May 30	Oct. 2	125
1908	Apr. 21	...do	175	.....	.....	.....
1909	Apr. 25	...do	171	May 12	Sept. 29	140
1910	Apr. 29	...do	167	May 16	Oct. 13	.....

Dates of the first and the last killing frosts and the length of the season between them—Con.

Year.	Newton, elevation 678 feet.			Charlotteburg, elevation 719 feet.		
	Last in spring.	First in fall.	Length of season.	Last in spring.	First in fall.	Length of season.
1900	May 11	Oct. 17	159	May 11	Oct. 17	159
1901	Apr. 13	Oct. 25	196	May 6	Sept. 26	144
1902	Apr. 20	Oct. 22	186	May 29	Oct. 10	135
1903	May 2	Oct. 25	176	May 3	Sept. 26	146
1904	May 3	.....	.....	...do	Sept. 22	142
1905	May 21	Sept. 27	129	May 30	Sept. 14	136
1906	May 11	Oct. 12	154	May 11	Oct. 12	154
1907	.....	.....	.....	May 12	Sept. 27	138
1908	Apr. 21	Oct. 13	164	May 2	Sept. 30	148
1909	Apr. 25	...do	171	May 3	Oct. 13	163
1910	.....	.....	.....	May 17	...do	149

AGRICULTURE.

The Sussex area was first developed agriculturally in the upper Delaware Valley. This, according to Small's History of Sussex and Warren Counties, was about 1680, though the exact date is not definitely known. From the beginning of settlement in the area agriculture was the leading industry, though the section was prospected over and its mineral resources recognized at an early date. The early settlers raised a diversity of crops, mainly subsistence crops. The products sold were usually such as could be easily transported to more or less distant markets.

The soils are naturally adapted to grass, and this was fed to cattle, which, after being fattened, were driven to market.

When the agricultural resources became known the Sussex area, especially the Kittatinny Valley, attracted so many settlers that production could not keep pace with the subsistence needs of the population. In 1790 the area comprising Sussex County[1] had a population exceeded by but one county in the State. About this time grist mills were erected on the valuable power sites in various parts of the area. This gave an impetus to the growing of grain, which could be sold at remunerative prices.

The following figures, showing the changes in the condition of the agriculture of Sussex County, give a good idea of the growth of the agriculture of the area as a whole.

In 1825 it was estimated that the principal exports of Sussex County were 900 tons of butter and 3,000 tons of pork and other meat. At this time such products as milk, young calves, poultry, eggs, and

[1] At that time all of Warren County was a part of Sussex, a fact which must be kept in mind in making the above comparison.

potatoes were of little value. Fruits were grown successfully, but comparatively little use was made of them. Indian corn, timothy, and clover were not introduced into the county until a comparatively late date. Until the railroads entered the county the principal products sold continued to be butter, beef, and swine. All the milk produced was skimmed and fed to pigs, while the cream was made into butter. These products were easily transported and brought good prices. Very soon after the railroads entered the area the shipment of milk was started. This industry has increased, especially in Sussex and Warren Counties. In 1870, 1,317,791 gallons were shipped from Sussex County and in 1900, 12,588,855 gallons.

Some other interesting comparisons are brought out by the census returns. In 1850 the value of farms in Sussex was given as $8,390,180, increasing to $13,264,703 in 1870. The figures for 1900 give the value of the land, improvements, and buildings as $6,834,120, and for 1910, $8,358,090. During this time the value of live stock remained about stationary. There has been a marked increase in the number of milch cows, a decrease in the number of sheep from 23,983 in 1840 to 4,832 in 1900, and 2,960 in 1910, and in swine from 30,263 in 1840 to 6,518 in 1900 and 4,958 in 1910. The amount of butter produced has decreased from 2,042,987 pounds in 1860 to 342,916 pounds in 1900, and 156,226 pounds in 1910. There has been a decrease in the production of buckwheat, wheat, oats, and rye, the output now being about one-third as much as in 1840.

At present dairying is the prevailing type of agriculture, with the production of general farm crops of next importance. Corn is the leading cereal crop. The Eight Rowed Yellow is the favorite variety, except where grown for silage, in which case the Dent varieties are found to give a heavier yield of stalks. Certain sections of the area have too short a growing season to permit of maturing the Dent varieties when grown for grain. For corn the land is plowed either in the fall or early spring. In case the field is steep, fall plowing of sod land is not advisable, while on level locations, where there is little danger of erosion, this practice is advisable. As early as possible in the spring a seed bed is prepared. In many instances too little care is taken in performing this part of the work, and poor yields can be ascribed largely to such neglect. The seed is planted the latter part of May or early in June, depending on whether the soil is early or inclined to be cold and late. Manure is usually applied at the rate of 10 loads per acre. In some cases fertilizers are also used, this practice being favored by some farmers, who claim that they promote growth early in the season. Mixtures composed of nitrogen, phosphoric acid, and potash in the proportion of 3–8–4, applied at the rate of 400 pounds per acre, are found to give good results.

But little cultivation is given the growing crop. In some sections it is the practice to use the one-horse plow. This implement should be displaced by the one-horse cultivator, which is found to give much better results, especially where the crop is cultivated several times instead of twice during the season. Harvesting is done largely by machinery where the crop is to be used for silage, but where raised for grain it is cut by hand labor.

Oats are raised extensively in the area, especially in the Kittatinny Valley. The most important recommendation in connection with this crop is a more careful selection of home-grown seed, or for better seed where it is brought from sections outside of the State. From field inspection it is noticed that many fields of this grain are produced from seed coming from very poor and weedy sections. These imported weeds prove very troublesome in many cases. There is also a tendency for the grain to rust, and areas thus affected invariably report a marked decrease in yield. Clover and grass are often sown with this crop.

Wheat growing in the Sussex area is of minor importance. This crop is not adapted to many of the soils of the county, and only limestone soils of the Dover series and the heavier types of the Dutchess, Hoosic, and Chenango series give remunerative crops.

Rye is the principal winter-grain crop of the area. In many cases it is sown after the corn is harvested, either alone or mixed with grass seed. This grain grows well and produces fair yields on practically all the soils in the area except those of limestone origin comprising the Dover series.

There are scarcely any farms in the area that do not keep a few cows, and in some cases herds number from 60 to 100 head, particularly in the Kittatinny and Vernon Valleys. The principal breeds are the Holstein, Jersey, Guernsey, and Dutch Belted. The average herd is made up almost entirely of grade Holstein, with a mixture of Jersey and Guernsey to bring the quality of the milk up to the standards set by the milk companies. The males of the herds are in many cases prue-bred Holsteins. In a few exceptional cases pure-bred herds are to be found in various parts of the area.

The general plan of managing the dairy herd is to produce the coarse forage on the farm and to buy the concentrated feedstuffs. A high price is paid for the latter. The coarse fodder is composed largely of hay, ensilage, and corn stover.

The use of corn for silage has decreased somewhat during the last few years because of the stipulations in the contracts of some of the milk companies that silage shall not be fed. This clause has been eliminated in many recent contracts.

The prevailing practice of buying nearly all of the concentrated feeds, while necessary under the present methods of cropping, prob-

ably could be improved upon by producing more of the grain feed on the farm. The change would in some cases necessitate a decrease in the number of cows kept, through lessening the area of pasturage and mowing land, but would give a greater opportunity for the rotation of crops and in the end prove more profitable. Even with the present system of dairying, the growing of more clover or other leguminous hay crops, such as cowpeas, vetch, Canada field peas, and alfalfa, would increase the amount of protein produced on the farm and lessen the amount which would have to be bought in costly concentrated feeds.

The prices paid for milk are regulated by the purchasing companies and are based on the prices of the New York exchange. As a rule the price is about one-half the retail price during the winter months and less than that during the spring and summer months. This condition is the cause of a great deal of dissatisfaction on the part of the farmers, who say that they are forced to make material changes in the method of handling milk at an increase in cost for which they are not properly paid.

The milk is hauled to the shipping stations, where it is inspected as to temperature and also as to the standards of both the State and purchasing company buying the milk. It is then recooled, to be bottled at many of the stations. In cases where it is not possible to haul the milk directly to the shipping station, it is drawn to a central point, where it is transferred to a regular wagon, which carries it to the station. In the section of the county west of the Kittatinny Mountains, where there is no train service, the product is in many cases sold to creameries, where it is made into butter. Near Glenwood the milk is sold to a condensing company. In very few cases is butter made on the farms. On few of the dairy farms are milk records kept, and the farmers do not know which cows are profitable and which are not. It is safe to say that at least one-fourth of the cows kept in Sussex County are not paying the cost of their keep, or are giving little net profit. Wherever the practice of weighing or testing milk has been tried and the individuals falling below a reasonable standard have been eliminated from the herds the results have much more than repaid the trouble and expense of keeping the records.

In the production of grass it is the practice to seed a mixture of timothy, redtop, and clover. The last few years considerable difficulty has been experienced in securing a good catch of clover. This has led to the belief that clover will not grow as well as formerly, and this is probably true where proper methods are not employed. Wherever lime is applied in connection with manure and a good seed bed prepared little difficulty need be expected and usually satisfactory results may be secured.[1]

[1] Farmers' Bulletin No. 455, "Red Clover."

Peach growing has declined greatly in recent years. However, this industry is being revived and promises to regain a part of its former importance. Extreme care is necessary to control the "yellows," and thorough spraying must be practiced to kill the San Jose scale. This pest is causing many orchardists considerable trouble, and where no attempt has been made to check it it has proved extremely injurious. Lime-sulphur solution in the spring and fall is used to combat this pest, with good results.

Apple growing has declined even more than the peach growing, particularly on account of the depredations of the San Jose scale. Before the invasion of this pest there were many good-sized orchards which were very profitable, and the industry seemed likely to supplant that of dairying. The fruit which is now produced in the majority of cases is of little value except for cider. The surface is spotted with scab and scale, and the fruit is wormy. In the few exceptional cases where spraying is resorted to the fruit is of good quality and color. The sprays used are the lime-sulphur and Bordeaux mixtures.

Poultry forms an important, though little-considered, source of revenue in the area. Nearly all farms have some poultry, but the industry has not received much attention as a specialty.

In the northwestern part of the area, on the terrace soils along the Delaware River, the most intensive trucking in the county is carried on. This type of agriculture is beginning to attract attention on the low-lying, black muck lands in various parts of Sussex County, and is recognized as one of the most profitable in the county. The principal crops grown are onions, cabbage, and celery. There are large areas of land well adapted to the production of these crops which are not utilized for this purpose at the present time, but they are being rapidly taken up and reclaimed.

Very little ferilizer is used in the county, except on corn, and in rare cases on grain. Manure is frequently applied to grass lands. It is claimed that the best results are obtained in this way. The rule is to remove the manure from the cow stables daily, depositing it in large heaps, where it decomposes and dries out. After it has reached the proper condition it is spread over the lands in the form of top dressing or harrowed in.

About 1850, or before, almost every farm had its lime kilns, to which stone was hauled for burning. The practice of liming, which was so generally followed, has been almost entirely abandoned except in a few scattering localities, where the practice is being revived. The good results which attend the use of lime are unquestionable, especially where it is desired to reestablish the growing of leguminous crops. In many sections the physical character of the soil would be improved by a moderate application of lime. Moderate applications

may be made at intervals of three or four years, with the idea of correcting any tendency toward acidity. The rate at which lime may be applied and the amount which is needed varies greatly with different soils, and even the same soils under different conditions. If the supply of organic matter is abundant it is possible to make heavier applications than is the case where it is nearly depleted.

In Kittatinny and Delaware Valleys there are large amounts of limestone available for burning. In the Highland district lime is more difficult to secure. Many of the old kilns could be repaired with comparatively little expense. Where both stone and fuel are handy it seems that it would be to the advantage of the farmers so situated to burn their own supply. At the present time the greater part of the lime used for agricultural purposes is brought into the area from the neighborhood of Portland, Pa.

The original forest growth has almost entirely disappeared. The forest areas are, however, practically intact in the Highlands (except the larger valleys) and on the slopes of Kittatinny Mountain, and the growth is capable of being renewed. It now yields no small amount of rough lumber, of small size and largely for local use, and a goodly number of crossties and mine props and lagging. In Kittatinny Valley there are many woodlots of varying size which supply the farms with timber and firewood.

Crop rotation is practiced to some extent, especially on the higher lying soils. On the heavier types, where it is possible to secure a good crop of grass for a series of years, the fields are plowed infrequently, and even then are used for tilled crops only long enough to put the land in good condition for reseeding.

Sheep raising could be carried on profitably in parts of the area. Wool brings good prices, and there are areas too steep for cattle pasture well suited for sheep. The chief danger is from dogs, and this possibly accounts for the small number of sheep kept at present.

The production of potatoes in the area amounts to about 150,000 bushels annually. The production could be greatly increased if the crop were made a money crop. It should prove profitable with up-to-date methods.

The farms as a whole, especially in the Kittatinny Valley and the limestone belts, have the appearance of thrift and prosperity. This is also especially true in certain sections west of the mountain. State and New York City milk inspection has had a tendency to improve the conditions of the farm buildings. The large number of summer boarders visiting some sections of the area, especially along the lakes and rivers, also brings considerable money to the area and provides a good local market for farm produce.

The value of farm lands varies, depending on the location, soil, and type of farming. The rough, stony lands have practically no value except for pasture and forest land.

The limestone soils of the Dover series and also the areas of Muck bring as high as $100 an acre.

SOILS.

The soils of the Sussex area are chiefly, although not entirely, of glacial origin. During the glacial period the moving ice field as it slowly advanced tended to drag along with it the soil which had been formed in preglacial times by the disintegration and decomposition of the various underlying rock formations. Armed with this material the ice sheet, acting as a flexible rasp, tended to break and grind off even the solid rock itself. As it advanced, some of this material lodged under the ice and new material was picked up, while at the front edge of the glacier, where the melting equaled the rate of advance, this rock débris accumulated in an ever-increasing amount. In places where the drainage from the ice was concentrated along certain lines the finest part of the material was swept away by the swiftly flowing water and the coarser was deposited as sand and gravel. As the rate of melting gradually exceeded the rate of advance and the front of the ice sheet receded, a mantle of débris, coarse and fine indiscriminately mingled, and of varying thickness, was deposited. This sheet of stony clay, technically called till, and the beds of clay, sand, and gravel deposited by the streams issuing from the ice sheet, form the basis of most of the present soils of the Sussex area.

The till is composed chiefly of material derived from the rock formation on which it rests. While this is true it also contains a certain percentage of material derived from more remote regions which the ice had carried longer distances. In general the thinner the till the greater the proportion of local material. Inasmuch as the grinding action of the ice is great, all material (except the very hardest) which was transported far was ground to powder. Hence the percentage of distantly derived material in the finer portion of the till is large.

Inasmuch as the ice which reached this region traversed rock formations of many kinds, and since the region itself contains a large variety of geological formations, the till presents several distinct phases, which depend chiefly upon the character of the underlying rock.

Locally the mantle of glacial drift was so thin that the present soil is practically the result of the decay and disintegration of the underlying rock. Essentially the same result occurs in those areas where the till is almost entirely of local material, and the admixture of

foreign material is extremely limited. In such cases the soil or subsoil, although technically derived from glacial material, may not be greatly unlike a soil or subsoil resulting solely from the disintegration of the rock beneath.

The upland types of soil fall naturally into soil series based generally on geological differences which influence their structure and general characteristics. They are closely related to the underlying rock formations which have entered so largely into the glacial till from which the soils were principally derived. A second class of soils is made up of materials derived from deposits of glacial waters during and immediately following the recession of the ice. These are classed as terrace soils. The third group comprises those derived from material eroded from higher localities and deposited for the most part during high water on the bottom lands along streams.

The soils of the Highlands belong chiefly to the Gloucester series. Here the underlying rock is gneiss and granite of varying types, classified according to color and composition, but the glacial drift derived chiefly from them shows little difference, and the soils, derived in turn from the drift, show less. The soils of the Gloucester series are as a rule the most sandy of the upland soils, but are less so than those of the terrace series. They contain considerable rather coarse quartz sand, the result of being derived from quartz-bearing material. Much of the till of this region is hardly more than reworked residual material, with the addition of little or no foreign rock. In many localities, therefore, the soils of this series closely resemble those derived directly from the decay of gneissic rocks. The Gloucester series as found in the Sussex area is made up of four types. These are the loam, sandy loam, stony loam, and stony sandy loam.

In Kittatinny Valley (including Sparta and Vernon Valleys), which is the most important physiographic division from the standpoint of agriculture, there are upland soils of three series, including the Dover, Dutchess, and Culvers soils. The underlying rocks are white crystalline limestones of pre-Cambrian age, bluish magnesian limestones, and shales, slates, and fine-grained sandstones of Cambrian and Ordovician age. The soils on the higher portions of the limestone areas belong to the Dover series, as typically developed in Dutchess County, N. Y. In some localities where the drift is thin a large amount of soil material has been derived from the underlying rocks by chemical decomposition. In the areas covered by some members of the series frequent outcrops of limestone of considerable size give the surface a warty appearance. Where the drift is thicker the underlying rock is of less importance in its relation to the surface soil. In this series three types of soil have been mapped, the Dover loam, fine sandy loam, and stony loam. The Dover loam has a light phase which consists of lighter loam than the typical soil.

The Martinsburg or Hudson River shales, slates, and sandstones of Ordovician age overlie the blue limestone. The till on this formation gives rise to the different types of the Dutchess series. These soils in all cases contain numerous angular fragments of slate and shale of all sizes which have been mixed with the soil mass either by glacial action or through the disintegration of the underlying rock. The amount of this angular rock material varies in the different soils of the series, but in all cases there is enough present to identify them as belonging to it.

The subsoils are in some places composed of disintegrated shale, the result of post-glacial weathering. The fine earth of these soils is principally silt. The coarse, shaly material, however, gives the different types a lighter appearance and also makes them susceptible to the drought which is almost certain to occur during some part of the growing season. The types of this series are the Dutchess loam, shale loam, and stony loam. The loam type is divided into two phases, namely, the loam and shaly loam.

In some portions of Kittatinny Valley a third series of upland soils, the Culvers series, is found. In this region it is derived largely from rather deep till. As a series, it differs from the Dutchess series in the depth of the till, the color of the soils, and the small amount of shale in them. In all cases the subsoils are a more distinct yellowish brown than in the case of the Dutchess series, where they are a slightly grayish yellow. In the Culvers loam and Culvers stony loam which occur east of Kittatinny Mountain the underlying rock formation is the same as below the Dutchess soils.

On the west slope of Kittatinny Mountain the underlying rock is red shale and sandstone, the Highfalls formation of Silurian age. The till mantle is usually relatively thin and for the most part thickly strewn with bowlders, many of which are the Shawangunk conglomerate which forms the crest and east slope of the mountain. The soils are of two types, a loam and a stony loam, belonging to the Lackawanna series and differing from the soils of other series of the district in color, which is reddish to pink. The loam type predominates and is inclined to be lighter in texture than the other upland soils in this part of the county. The series derives its name from the Lackawanna Valley in Pennsylvania, in which similar soils occur.

Along the Upper Delaware and west of Kittatinny Mountain there are limestones and calcareous shales of Silurian and Devonian age. They are overlain by limestone soils derived from till and to a less degree from the underlying rock. Four types are represented—a silt loam, having a heavy subsoil phase, a stony loam, and a shale loam, both of which are largely of residual origin, and a fine sandy loam. This series, which is called the Wallpack series, differs from the Dover series in that a much larger amount of the soil is of residual origin and

the rocks of the region have contributed more shaly material than found in the Dover soils.

The terrace soils of the district are classed as the Hoosic, Fox, and Chenango series. They occur on sand and gravel deposits made by the glacial waters from the melting of the great ice fields during the closing stages of the glacial period. Both soils and subsoils are characterized by rounded waterworn pebbles and small stones. Within the areas covered by these series there is great variation in the soils, even within narrow limits. In many localities all the different types of a series occur within a single field. These areas are, however, too minute to map separately, and in such places only the prevailing type can be represented. The subsoils vary greatly with variations in the underlying rock formations. In some cases these subsoils are highly calcareous, an important proportion of the small stones or gravel pebbles consisting of limestone, and at the lower depths are cemented together by the action of the calcium carbonate which has been leached from the overlying material. Such soils are grouped in the Fox series. In other cases the subsoils are distinctly sandy, especially within the Highlands, while in the regions underlain by the Martinsburg shale much of the subsoil is derived from that formation and these soils are placed in the Hoosic series.[1] Terrace soils occur at nearly all elevations, although chiefly along the lines of present or glacial drainage, and in all parts of the district and independent of the geological formations.

The soils in this region on the terraces along the upper Delaware River are referable to the Chenango series. As a general rule they are made up almost entirely of fine material and are inclined to be sandy and contain very little gravel. Below, however, there is a gravel substratum, sometimes coarse, but this has little influence on the overlying soils.

The lowland soils on tracts subject to inundation and formed by deposition of material during times of overflow, but in a well-drained condition are classed in the Genesee series. A few other series represented by single types have been mapped and will be described below.

Muck soil occurs in large areas in the district and is made up of a large amount of organic matter partially decomposed. In some sections of the region there are deposits of shell marl overlain by deposits of muck. These are not in any way developed and are classed with the muøk soils.

In addition to the soils described there are small areas of "made" land, a self-explaining term. Wasteland occurs where the railroads have made great excavations over considerable tracts for ballast.

[1] It is probable that some of the areas mapped as Hoosic should be classed as Merrimac, a terrace series formed of material derived from crystalline rocks.

Along the crest of Kittatinny Mountain occurs the most unproductive soil in the region. It is derived from till deposited in very thin layers over the Shawangunk conglomerate. This is a thin soil and generally poor; in fact, it is so thin and the rock so near the surface that areas occupied by it can be mapped as rock outcrop.

The following table gives the name and extent of each type mapped in the Sussex area:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough stony land	134,080	26.6	Hoosic sandy loam	5,888	1.2
Dutchess shale loam	54,272	10.8	Genesee loam	3,712	.7
Dutchess loam	9,728	7.2	Culvers loam	3,328	.7
Shaly phase	26,688		Dutchess stony loam	2,816	.6
Rock outcrop	28,160	5.6	Chenango fine sandy loam	2,240	.4
Hoosic gravelly loam	26,240	5.2	Wallpack shale loam	2,176	.4
Gloucester stony loam	23,936	4.7	Gloucester sandy loam	1,664	.4
Culvers stony loam	23,360	4.6	Gravelly phase	192	
Dover stony loam	21,632	4.3	Wallpack stony loam	1,664	.3
Dover loam	18,112	4.2	Wallpack fine sandy loam	1,408	.3
Light phase	3,200		Fox gravelly loam	1,408	.3
Lackawanna stony loam	18,624	3.7	Chenango loam	832	.2
Muck	18,240	3.6	Chenango sandy loam	768	.2
Gloucester stony sandy loam	13,184	2.6	Wallkill silty clay loam	704	.1
Lackawanna loam	12,928	2.6	Chenango silt loam	576	.1
Meadow	10,752	2.1	Chenango fine sand	512	.1
Papakating silt loam	10,432	2.1	Dover fine sandy loam	512	.1
Wallpack silt loam	3,584	1.4	Wasteland	488	.1
Heavy subsoil phase	3,648		Chenango sand	384	.1
Gloucester loam	6,080	1.2	Total	504,320	
Silty phase	128				
Hoosic loam	6,080	1.2			

DUTCHESS LOAM.

The surface soil of the Dutchess loam consists of a friable, light-brown to brown heavy loam to silty loam or silt loam varying in depth from 8 to 10 inches. The subsoil is a light-brown to yellowish-brown silty loam which at 18 to 28 inches forms a compact stratum known as "hardpan." The material below the hardpan contains considerable sand and is somewhat lighter in texture than the overlying soil.

Slate and shale fragments are found in varying quantities throughout the soil section, usually forming about 10 per cent of the soil mass. A few large bowlders occur in the soil and a number of large-sized rocks are scattered over the surface. These are usually dark-colored sandstone from the coarser layers of the Martinsburg formation or light-colored quartzites and conglomerate from the Shawangunk conglomerate found on Kittatinny Ridge, a hard, resistant rock of a characteristic grayish color.

The type occupies gently sloping areas and hilltops in the Kittatinny Valley in what is known as the slate and shale district. Drainage as a whole is well established, although the hardpan layer tends to restrict the downward movement of soil moisture.

The Dutchess loam is of glacial origin, occurring where the till attains considerable thickness and where the underlying shale and slate formation is not sufficiently near the surface to be affected by frost action. Although the till is in large measure composed of material derived from the underlying rock, there is a considerable admixture of foreign material, and much of the local material was that which had been decomposed in preglacial time and also that which was ground to rock flour by glacial action.

The soil is friable and easily cultivated, providing plowing is done under proper moisture conditions; otherwise it tends to clod and is difficult to handle. The shale and slate content aids rather than interferes with cultivation.

The Dutchess loam is naturally adapted to the growth of deciduous trees, especially oak and chestnut, and in a few cases excellent forests of these species are found.

General farming is the prevailing type of agriculture, wheat, corn, oats, and rye being the principal grain crops. Unlike the lighter members of the series, wheat is grown successfully on this type, rye being substituted for this crop on the other types. The yield varies from 15 to 25 bushels, with an average of 20 bushels, per acre. Grass, especially timothy, gives excellent results on this soil. The average yield is probably about 1¼ tons per acre, but a large part of the areas covered by this type produces from 1½ to 2 tons under favorable conditions.

Dairying is extensively carried on and an effort is made to produce as much feed as possible. Corn for silage is grown extensively. Clover was formerly of considerable importance, but in late years, following the exhaustion of the lime which had been previously applied to the soils, a good stand of clover is exceptional. However, in sections where lime and stable manure have been applied good clover crops are still obtained.

The raising of leguminous crops would decidedly enrich the soil. Canada field peas sown in connection with oats produce an early forage crop which could be cut and fed green, made into hay, or allowed to mature and be thrashed for grain.

Soy beans would also improve the soil. There is some question as to the success of alfalfa. Where good drainage conditions prevail and heaving can be controlled, after an application of lime and manure a good stand would probably result. The crop, however, should be tried experimentally at first.

Potatoes are grown in small quantities. With proper fertilizer treatment this crop could be made important. In the past apples and other orchard fruits were profitably grown. If more attention were given to the control and destruction of insect pests, this could still be made an important industry. The Baldwin and Rhode Island Greening are especially suited to this soil. The type is a little heavy for peach growing. The type is in need of lime; 40 to 50 bushels per acre would not be excessive, if applied in connection with a green crop plowed under or in conjunction with applications of manure.

The agricultural value of the Dutchess loam is the highest of any of the Dutchess soils. In several cases large areas of this type are valued at $40 to $60 an acre, and exceptionally good farms bring $75 an acre. The general prosperity and substantial buildings on this type in the Kittatinny Valley were especially noticeable.

Dutchess loam, shaly phase.—The surface soil of the Dutchess loam, shaly phase, consists of a light-brown to grayish-brown, silty loam from 6 to 12 inches deep, carrying considerable thin platy slate and shale. The subsoil is a grayish-yellow silt loam to loam with a high content of gravel and shaly material, ranging from 30 to 60 per cent of the soil mass. The structure varies with the shale content but the phase is friable and always easily worked.

With the exception of a small area near Postville, the shaly phase is confined to the Kittatinny Valley, where it occupies gently sloping to rolling areas on the ridges. Drainage is ordinarily adequate, although poorly drained, springy spots are occasionally encountered too small to indicate on the map.

The phase was originally covered with oak and chestnut forest. At present characteristic plants in neglected fields are sumac, blackberries, and "five-finger."

In productivity the phase is intermediate between the shale loam and the loam, averaging from 15 to 18 bushels of rye as compared with 12 to 15 bushels on the shale loam, and 18 to 20 bushels per acre on the loam type. Very little wheat is produced, the soil being considered too thin for this crop. Corn yields from 25 to 45 bushels per acre, the average being about 35 bushels. Where it is grown for silage and manure is applied, excellent crops are produced. Under proper management the production of potatoes could be made a valuable adjunct to dairying.

Oats are grown to some extent though the yields are variable. Buckwheat is grown extensively. Clover without applications of lime and manure does not do well as a rule. In cases where the land has been maintained in good condition this crop is successful. As a rule seedings of timothy and redtop are profitable, and the sods last one season longer than on the shale loam.

Peaches were at one time successfully grown in Sussex County, and on this phase the fruit produced was of excellent quality. With proper care of the trees this industry could be renewed on this type. Apples grow well, although the loam is a little better adapted to this crop than the shaly phase.

Basic slag in connection with manure would improve the soil, especially for clover, and in case lime in the form of burnt limestone is not available, it could be used in this form. Care should be exercised in applying lime, and only enough should he applied to correct any acidity present.

The condition of the farms and buildings on this phase is considerably better than on the Dutchess shale loam and well up to the average throughout the area.

Land values have increased rapidly during the past few years, the phase now commanding prices ranging from $20 to $50 an acre, depending upon location and improvement.

The following table gives the average results of mechanical analyses of samples of the typical soil and subsoil of the Dutchess loam:

Mechanical analyses of Dutchess loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23194. 25063.....	Soil.....	5.4	6.4	3.0	6.6	11.1	51.1	16.4
23195, 25064.....	Subsoil.....	5.4	9.1	5.1	9.9	14.3	36.8	19.4

DUTCHESS SHALE LOAM.

The surface soil of the Dutchess shale loam consists of a smooth, friable light-brown to grayish-brown, silty loam to silt loam from 4 to 9 inches deep, which becomes a distinct gray when dry and contains from 40 to 75 per cent of shaly, and slaty material. The subsoil is practically the same in texture as the soil, ranging in color from grayish brown to grayish yellow, the lighter color being found in areas of deficient drainage. The organic-matter content of the type is low. In cases where the rock material in the surface soil has been sufficiently broken a gravelly silt loam type is developed.

Partially decomposed rock fragments are often found throughout the soil section, the proportion of shaly material depending upon the closeness of the underlying shales and slates known as the Martinsburg and Hudson River formations. Where the soil mantle is thinnest the rock fragments often form the greater part of the soil mass. Such areas are usually of rough, uneven topography. Bowlders of other formations than the parent rock are occasionally found over the type.

The soil is essentially the result of the decomposition and disintegration, mostly in post-glacial time, of the underlying rock. Locally the ice sheet left a thin veneer of debris, but over most of the tracts covered by this type its contribution was scarcely more than scattered bowlders and small stones, many of them derived from near-by ledges of sandstone and others from more distant formations. Ordinarily these are not so numerous as to affect the agricultural possibilities of the soil. In some localities, notably along the base of the Kittatinny Mountain, this is not the case. In the Longwood-Greenwood Lake Valleys on a shale of different geological age, there are areas of this soil marked by numerous rock ledges.

The type occupies gently rolling to rolling areas. Portions of the more resistant rocks are found on the slopes in terracelike formation. Over such areas the soils are generally deeper and more productive, resembling in this respect the shaly phase and main type of the Dutchess loam.

The Dutchess shale loam is the most extensive type of the series and occupies a large part of the Kittatinny Valley. The areas occur as ridges traversing the valley. One of the most extensive areas of the type occurs as an irregular group of ridges running from a point south of Sussex in a southwesterly direction past Newton and out of the area south of Hainesburgh.

The topography of the type is generally gently to steeply rolling. The gently rolling areas have a characteristic hummocky topography which is unlike any other type of the area. The elevation at which this type occurs varies from 400 feet in the southwestern section of the area to over 1,000 feet in the vicinity of High Point.

Small areas of the Dutchess shale loam are closely allied with the shaly phase of the loam type of the same series, the shale loam occurring on the more broken portions where erosion has been most active.

The Dutchess shale loam is inclined to be droughty during the growing season, this feature being more pronounced than on any other type found in the area, with the possible exception of the coarser grades of the Hoosic gravelly loam. This is due to the rapid run-off of surface waters caused by the rolling surface and by the shallow subsoil, which can not store sufficient moisture to carry crops through seasons of protracted drought.

The native forest growth is mostly oak and chestnut. On the steeper portions of the type the forest growth is more valuable than any other product.

The crops grown on the Dutchess shale loam are rye, corn, and hay. The rougher areas are used for pasture. Rye gives fair yields of grain and straw, ranging from 8 to 15 bushels per acre. With liberal applications of manure and careful treatment to conserve the

soil moisture supply, corn gives excellent yields. The hot, dry spells during July and August frequently kill all grass, with the result that seedings last but from 1 to 3 years, when the soil must be plowed and reseeded. Clover does not generally succeed unless extra care is taken to apply organic fertilizers and lime.

Apples have been grown successfully on this type, and with proper care can be made to yield well. Peaches were formerly a good crop, and remains of old orchards still stand, marking the sites of formerly productive areas.

The most urgent need of this type is to increase its organic-matter content by generous applications of stable manure or by turning under green crops. Wherever possible leguminous crops should be used, as they add nitrogen to the soil. The presence of sorrel and five-finger indicates soil acidity—a condition that can be corrected by applications of lime.

Chiefly on account of its tendency to drought, the type is not considered a valuable soil. Locally it is known as "slate land." The greater part of it is in grass or pasture. The more level areas are cultivated and planted to tilled crops. Buckwheat is grown extensively, though yields are uncertain, as droughts during the growing season are apt to cause a poor stand and lack of moisture late in the season is likely to prove injurious to the crop.

Land of this type is held at prices ranging from $10 to $35 an acre, depending largely upon location and adaptability to cultivated crops.

The following table shows the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Dutchess shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23192	Soil	9.0	7.9	2.4	4.1	9.7	44.4	22.4
23193	Subsoil	4.4	8.0	3.6	6.9	16.9	39.0	21.2

DUTCHESS STONY LOAM.

The surface soil of the Dutchess stony loam consists of 6 inches of a brown or drab, silty loam. The subsoil is a yellowish-brown to yellow, silty loam to silt loam, occasionally showing bluish mottlings. Both the soil and subsoil carry variable quantities of shale fragments and rocks from 6 inches to several feet in diameter.

The rock content makes cultivation impracticable. Areas of this type are confined entirely to the Kittatinny Valley, the largest areas

lying in the vicinity of High Point, in the extreme northern part of the area. The type here forms level to rolling areas of varying drainage.

The type is derived mainly from the weathering of the till from the Martinsburg shale mixed with bowlders from adjoining areas of Shawangunk conglomerate. This formation gives rise to the large, hard gray rocks which form such a pronounced feature of this soil.

The native vegetation consists of oak and chestnut. The only use made of this soil is for pasturage, for which it is fairly well suited. Because of its poor drainage, it is utilized, especially during the dry season, for pasturage of milch cows and other stock.

GLOUCESTER LOAM.

The surface soil of the Gloucester loam consists of a light-textured brown loam, from 8 to 10 inches deep, which is loose and friable under cultivation owing to its high content of medium and fine sand. Small mica fragments may be present in the soil, in some cases giving it a slightly greasy feel. The subsoil to a depth of 8 to 20 inches is a brown to yellowish-brown loam to light loam, containing a somewhat higher content of coarse sand than the surface soil. In the lower portion of the soil section, with the decrease in organic-matter content, a compact structure is developed with depth, forming what is locally known as hardpan, although differing from the true hardpan in not being cemented. Below 24 inches there is a tendency to a more sandy texture and the material is composed of a less weathered till, or in many instances of material derived through the decomposition of the underlying rock. Numerous small fragments of gneiss rock are found in the soil and subsoil. The stone content of the type is much less than in the Gloucester stony loam. This is especially true as regards the large rocks which interfere with cultivation.

The topography is fairly level to rolling. Where the slopes are steep, the soils are thinner and the loose rocks have not been removed and the Gloucester stony loam is developed.

The Gloucester loam occurs for the most part in relatively small areas in the Highland portion of the survey. Those nearest the western margin have a noticeable content of shale and limestone derived from those formations to the northwest and hence differ in texture from the other areas in which the soil is composed essentially of gneissic and granitic residuary material reworked by the glacier.

The type is derived from the glacial till occurring over the Losee, Byram, and Pochuck gneisses. In some cases it is probable that a part of the subsoil is made up of residual material derived from the underlying rocks. A small section situated in the extreme southwestern part of the area rests upon Triassic rocks and is therefore in no way typical, but included with the type, as it was deemed inadvisable to establish another series for this one area.

General farming is the prevailing type of agriculture. Corn gives good yields, from 40 to 70 bushels per acre being secured under ordinary conditions with careful farming. Rye is grown instead of wheat, yielding about 20 bushels per acre. Considerable hay is grown, from three-quarters of a ton to 1½ tons per acre being the average yield. The greater part of the type has been cleared of rocks, which have been piled into fences. Practically all of the native timber growth of chestnut and oak has been removed. Among the fruits, apples and peaches are grown successfully, the Baldwin being the most common variety of apple. Peaches are best grown on the lighter phases of this type, the Elberta and the Iron Mountain being the varieties best suited to the local conditions. The stony loam type is better adapted to pasturage.

The type can be greatly improved by the use of lime and organic manure. These amendments are necessary in the growing of clover. The effects of manure are fairly permanent.

The value of the Gloucester loam depends on the location and improvements, and ranges from $25 to $50 an acre. In general appearance the farms and buildings located on this type are substantial and usually better cared for than farms on the other members of the series.

Gloucester loam, silty phase.—In the extreme southeastern part of the area a small tract of this type has been shown upon the map as a silty phase. The soil is here a brown silt loam from 6 to 7 inches deep. From 7 to 36 inches the color is yellowish brown and in some cases a slightly reddish brown. It gradually becomes more grayish and mottled with dark yellowish brown below 20 inches. The surface and soil have a considerable amount of subangular gravel and cobbles. This soil, like that of the more northern areas, is derived from glacial till of considerable thickness, made up of the debris from crystalline rock. It was deposited, however, over the Triassic rocks of the Newark formation and lies outside of the true Highlands of New Jersey. So little of this nontypical phase was encountered that it was not considered desirable to establish a new series for its occurrence. Topographically, it is encountered adjacent to tracts of bottom land and is but a few feet above it, though its drainage is well established.

The following table gives the result of mechanical analyses of samples of typical soil and subsoil of this type:

Mechanical analyses of Gloucester loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25065	Soil	3.1	9.7	8.6	20.5	13.6	33.8	10.3
25066	Subsoil	4.0	10.4	9.0	20.7	16.5	29.3	10.0

GLOUCESTER SANDY LOAM.

The surface soil of the Gloucester sandy loam consists of a light-brown to yellowish-brown sandy loam to light loam, loose and friable, and from 8 to 10 inches deep. Frequently enough finely divided mica flakes are found throughout the soil mass to impart a slightly greasy feel to the soil. This feature is more marked, however, in some of the other types. The subsoil is a yellowish-brown to yellow sandy loam, the sand content becoming greater and the grains coarser with depth. A slight tendency toward hardpan is noted, although the compactness of the soil mass does not prevent the downward movement of soil moisture.

The Gloucester sandy loam is most extensively developed in the south-central part of the area, and is entirely confined to the belt of country underlain by gneiss. The areas are usually of small extent, the type having the smallest acreage of any of the Gloucester series. The principal area occurs on the west side of Briar Ridge, where it is somewhat stony. Small areas are found in the townships of Sparta, Byram, and Andover in Sussex County.

The type is derived from glacial till, composed largely of gneissic and granitic material, although the lower subsoil may have the appearance of being of residual origin. In road cuts it is seen to be banded, resembling in this respect the unweathered rock. The stone content is lower than in any other of the Gloucester soils. Rocks were at one time numerous over the surface, but they have been removed and used to build fences. The soil mass contains a large quantity of small rock fragments.

The native vegetation consisted principally of deciduous trees, particularly chestnut and some oak. At the present time practically all of the type is cleared.

Grass, corn, rye, and oats are the principal crops. These crops give satisfactory results, although the soil is more inclined to be droughty than the loams of the same series. Peach growing has been carried on very successfully, although the "yellows" and San Jose scale have been troublesome. The type is well suited to peaches, being well drained and easily tilled. Hay gives rather light yields, from one-half ton to a ton being obtained as compared with the loam, which yields one-fourth of a ton more under the same conditions. On account of the more open structure of the soil, the type is not as well adapted to grass as some of the other members of the series. In some cases it is difficult to secure a stand, the grass being crowded out by five-finger, which thrives on the lighter soils. Buckwheat is grown successfully, giving fair yields.

The type varies widely in value, the average price being about $30 an acre.

Gloucester sandy loam, gravelly phase.—The gravelly phase of the Gloucester sandy loam, to a depth of 8 inches, consists of a brown, heavy, sandy loam, carrying a large quantity of gravel. Continuing to 24 inches, the color is yellowish brown, the texture becoming heavier with depth. A hardpan stratum in some cases is encountered in the lower part of the soil section.

This phase is derived from glaciated materials deposited over Triassic rocks. The topography is gently rolling, the phase occupying much lower situations than any of the surrounding members of the series. The gravelly phase is well adapted to truck crops and can also be used for apple and peach orchards.

The following table shows results of mechanical analyses of samples of typical soil and subsoil of this type:

Mechanical analyses of Gloucester sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
20963	Soil	5.5	14.7	8.9	20.8	11.8	27.6	10.8
20964	Subsoil	4.1	15.9	10.7	23.9	10.5	25.8	9.1

GLOUCESTER STONY LOAM.

The surface soil of the Gloucester stony loam consists of a light-brown to brown loam from 7 to 10 inches deep, carrying sufficient sand of the medium and fine grades to make the structure friable. The subsoil is a light-brown to yellowish-brown loam, fairly compact at 15 to 20 inches, and becoming more sandy and lighter in color with depth until at 36 inches it is a yellow or brownish-yellow sandy loam. Numerous small rock fragments are found throughout the soil mass. The subsoil in the lower portion resembles residual material, and may be derived from the underlying rock. Mica flakes are occasionally found in sufficient quantities to impart a greasy feel to the soil. This, however, is not a predominating characteristic as in the Gloucester soils found in the New York and New Hampshire areas.

The stone content of the Gloucester stony loam is in many places sufficient to make cultivation practically impossible. The type is known as "gray rock" land. Some of the least stony fields are used for tilled crops, but as a whole the best use of the type is for pasture. The bowlders are usually from 2 to 6 feet in diameter and are largely of gneiss, rounded and worn by glacial action and the natural processes of weathering. The underlying rock formations are the same as those beneath the other members of the Gloucester series—namely, Losee, Byram, and Pochuck gneisses.

There are some boggy places scattered over the type, but they are not of sufficient importance to warrant separation. Some hay is cut, but the large number of rocks makes the use of machinery impracticable, and hand labor is too expensive. The type affords the best pasturage of any member of the series and it is used principally for this purpose.

Where cultivated, yields of corn and other crops are satisfactory. A very small part of this type is plowed each year, the practice being to plow only as often as it is necessary to reseed.

The larger areas of the Gloucester stony loam are found in the northeastern part of the area, although areas are found in all parts of the Highland Belt.

The Gloucester stony loam occurs as gently rolling to rolling areas, usually near the tops of the Highland ridges in the eastern part of the area, and as bodies of more stony land bordering the Gloucester loam areas. Like other members of the series, it has been derived from the till of the last glacial epoch, which was composed in large part at least of the gneissic residual material covering the Highlands in preglacial or interglacial time.

Where properly drained and where the stones are not numerous enough to interfere with tillage, apples would do well. The land is also suitable for sheep raising. The forest growth is deciduous, chestnut and oak predominating. Blight is attacking the chestnut, and many trees are dying. The growth of timber is better on this type than on the Rough stony land, as the soil is in nearly all cases much deeper.

A phase of the Gloucester stony loam found in the vicinity of Oak Ridge and Newfoundland is underlain by shale and contains some material from this rock. It occurs in small areas and varies so slightly from the general till material of the Highland district that it was not considered necessary to separate it from the Gloucester stony loam. The soil of such areas is more loamy and contains more clay in both the soil and subsoil than the typical soil.

GLOUCESTER STONY SANDY LOAM.

The Gloucester stony sandy loam consists of a light-brown to yellowish-brown, heavy, sandy loam, from 7 to 10 inches deep, underlain by a yellowish-brown sandy loam subsoil becoming more sandy with depth and more yellow in color.

In some parts of the area there is a close relationship between the Gloucester stony loam and the Gloucester stony sandy loam in that they are made up of the same general class of material except for the difference in texture. As a rule, the distinction between the two types is very evident, though in some cases there is a very

gradual transition from the heavier sandy loams to the lighter loam type. In exceptional cases fine mica is found mixed with the soil mass. This, however, is not of enough importance to give the soil any very marked characteristic or to affect its texture to any great extent.

Stony material from small angular fragments to well-worn glacial bowlders several feet in diameter is found both on the surface and embedded. Even where large numbers of them have been piled into stone fences the plowed fields present a noticeably stony aspect.

The Gloucester stony sandy loam is found in comparatively small areas throughout the gneiss belt in the south-central part of the area, where it is associated with other members of the same series. It is an upland soil occupying the sides and crests of hills in the Pochuck Mountains, the Pimple Hills, and the eastern parts of the Highlands. The type, as a rule, is well drained, the sandy soil allowing the escape of water downward and its topographic position favoring ready run-off.

The till from which this soil is principally derived originally came from the decomposition and disintegration of the Byram, Losee, and Pochuck gneisses. In exceptional cases rocks from the other formations are found, but these do not have an important influence upon the soils. These foreign rocks are principally shale and limestone. At least 90 per cent of the rock in the soil is gneiss.

The natural forest growth of this type is identical with that of the other members of the series, being principally deciduous and chiefly chestnut and oak.

A large part of this type has been cleared and used for general farming. With liberal applications of manure and the use of lime, good crops of corn, oats, rye, and grass are grown. Corn varies from 35 to 60 bushels per acre. Little or no wheat is grown. Peaches do well, and with care and attention to guard against pests this industry could be extended. Apples do better on the heavier soils although some are grown on this type.

The stone content is the greatest obstacle to the extensive use of this soil. Under present conditions grass runs out after a short time, being replaced by weeds. Lime proves beneficial, particularly in the case of forage crops. In the case of the more stony fields, it is suggested that they be allowed to revert to the native forest growth, as the lumber would prove more remunerative than their utilization as pasture land. Peach growing should also be increased, and with ordinary care could be carried on successfully. In importance this type ranks about with the Gloucester stony loam.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Gloucester stony sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
24251	Soil	4.5	11.1	9.4	21.4	13.1	31.9	8.5
24252	Subsoil	4.5	11.4	9.8	23.0	15.1	23.9	12.0

ROUGH STONY LAND.

The Rough stony land includes areas too steep and rough for cultivated crops. As mapped this type also includes small, isolated areas, formerly cultivated but now reverted to forest.

Rough stony land is found in all parts of the Highlands in Sussex and portions of Passaic and Morris Counties. A small area of the type is found about 3 miles south of Johnsonburg in Warren County forming the northern extremity of Jenny Jump Mountain.

The Rough stony land is derived from the same formations as the Gloucester types. The soil material is a loam to sandy loam in texture and of loose, friable structure.

The most profitable use of this type is in forestry. Cleared areas, by reason of their steep topography, soon erode, the light soil mantle, in some instances, being entirely washed away. The timber growth consists principally of chestnut and oak of different varieties. The more level areas might be utilized for tree fruits and some of the gentler slopes for grass and pasture. Sheep raising might also prove profitable.

The value of the type varies according to the stand of timber from $3 to $10 an acre, and even higher. In the eastern part of the area over that section to be reforested by the Newark Water Board, some land of this type is held as high as $50 an acre.

CULVERS LOAM.

The Culvers loam has a heavy, brown surface soil underlain by a yellowish-brown subsoil sometimes showing traces of red. Stone fragments are numerous throughout the soil profile, although they do not interfere with cultivation.

This type occupies gently rolling to rolling uplands extending from south of Fairview Lake to the vicinity of the Delaware Water Gap.

The type is derived from the deep till overlying the Martinsburg shales, although this formation apparently has had little influence on the soil. From the rock fragments found on the type it appears that

the rocks forming the Kittatinny Mountain contributed extensively to the soil material. Drainage is frequently poorly established, owing to the formation of a compact stratum in the subsoil which does not allow the escape of water. This naturally affects the value of the type.

Buckwheat is grown quite extensively on this soil. Some rye is also produced and in exceptional cases corn is raised.

A large part of the type is covered with oak and chestnut. Grass does fairly well for either hay or pasturage.

The value of farm lands ranges from $10 to $25 an acre.

CULVERS STONY LOAM.

The surface soil of the Culvers stony loam consists of 4 to 9 inches of brown to drab loam or silty loam, usually friable, though inclined to be sticky when wet. The subsoil varies from a yellow to a yellow and gray mottled loam to clay. Rocks ranging in size from a few inches to several feet in diameter are found in large numbers on the surface and throughout the soil section, making cultivation impracticable. One may frequently cross a field without stepping on a stone less than 6 inches in diameter, and by far the greater number exceed this size.

This type is found almost entirely east of the Kittatinny Mountain, on the gently rolling to rolling slopes of the hills and ridges of the Kittatinny Valley. The type owes its origin to the weathering of a comparatively deep till. The origin of the materials is not altogether apparent, but the presence of a large number of bowlders of the Shawangunk conglomerate indicate that some of it has come from this source. The type has the local name of "gray-rock land."

The native vegetation consists almost exclusively of oak and chestnut, though when cleared grass readily forms a dense growth, affording valuable pasturage.

On account of the high stone content the Culvers stony loam is used only for pasturage, to which it seems well adapted, since drought affects it less than any other upland type in the area. Apple growing might be attempted, although the success of the undertaking is questionable.

Some attempts have been made to clear areas of this soil for cultivation by removing the stones from the surface and piling them at the sides of fields. Even when this has been done at considerable expense for labor the stones and bowlders in the soil make cultivation practically impossible.

The value of the type varies, depending on transportation facilities. The average price is $25 an acre, although in some cases $10 an acre is considered a high price for land of this type.

WALLPACK SILT LOAM.

The surface soil of the Wallpack silt loam consists of a friable silty loam to silt loam, from 6 to 8 inches deep, containing a large number of thin, cherty, and shaly fragments. The soil is brown when moist and a decided gray when dry. The shaly fragments combined with the high silt content give the type a decidedly friable structure. The subsoil is a yellowish-brown to grayish-brown silty loam to loam, containing fragments of limestone larger than those usually found in the surface soil.

This type occurs on the western slope of the Wallpack Ridge as an irregular and broken band stretching from the neighborhood of Flatbrookville to the vicinity of Montague. The topography is gently rolling to rolling, and in all cases affords sufficient drainage.

The Wallpack silt loam owes its origin to glacial till which has been derived principally from cherty and shaly limestones of the Devonian age.

The forest growth is similar to that of the other upland type of the area, consisting of oak and chestnut. The type is considered the best of the upland soils west of the Kittatinny Mountain.

Wheat and rye do fairly well, rye yielding from 15 to 18 bushels per acre, and wheat slightly more. Oats yield as much as 40 bushels, with an average of about 30 an acre. The yield of corn under favorable conditions varies from 70 to 80 bushels per acre, and hay from three-fourths ton to 2 tons, with an average of 1¼ tons per acre. Buckwheat does not do as well on this type as on the heavy subsoil phase.

Land values are fairly steady at $30 an acre, altl ough this figure may be exceeded for exceptionally well-located and improved farms.

Wallpack silt loam, heavy subsoil phase.—The surface soil of the heavy subsoil phase of the Wallpack silt loam consists of a brown silt loam about 8 inches deep, which becomes gray when dry. The subsoil is yellow, and to a depth of 20 to 24 inches practically the same in texture as the surface soil, gradually becoming lighter in color and more compact in structure until at 24 inches a slight hardpan is developed. In the lower portion of the soil section the subsoil is often a grayish yellow.

The Wallpack silt loam, heavy subsoil phase, occupies level to gently sloping areas in the central part of the Wallpack Ridge near Flatbrookville, extending in irregular and broken tracts in a northeasterly direction along the ridge. Drainage, as a rule, is well established.

The glacial till from which the soil was derived is of moderate depth and while the underlying rock formations have contributed largely to its make up, there is no lack of foreign material, so that

the soil does not bear so close a relation to the underlying rock as do some other types.

All of the general farm crops of the area are grown with good results. Corn yields range from 25 to 60 bushels per acre, depending upon the treatment given the crop. Oats yield from 25 to 30 bushels per acre, and with proper cultivation potatoes can be made to yield from 100 to 150 bushels to the acre. Buckwheat does well, the yield depending upon the moisture conditions during the growing season. Timothy and redtop predominates among the grasses. It is difficult to secure a good stand of clover unless lime is used in conjunction with manure. Basic slag in acreage applications of 300 to 400 pounds may be used on this crop with good results. This material supplies both lime and phosphorus.

This phase is considered a fair agricultural soil, although in many cases allowed to run down where not conveniently located for marketing crops or securing commercial fertilizers, or allowed to deplete itself through failure to maintain the organic matter content of the soil.

Land values range from $15 to $30 an acre, depending upon location and improvements.

The following table shows the results of mechanical analyses of samples of the typical soil and subsoil of this type:

Mechanical analyses of Wallpack silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25546	Soil	2.1	5.5	4.2	11.3	12.1	53.7	11.1
25547	Subsoil	3.7	5.2	3.9	10.1	12.7	48.9	15.6

WALLPACK STONY LOAM.

The surface soil of the Wallpack stony loam consists of a brown loam underlain by a brown to yellowish-brown subsoil of about the same texture. On account of its rugged topography this type is not utilized for cultivated crops and furnishes only a small amount of pasturage. The forest growth consists of chestnut and oak, with an occasional dogwood and cedar.

The type is confined to the steep slopes of Wallpack Ridge, west of the Kittatinny Mountain. It is composed largely of residual material from cherty limestone.

This type was separated from the Dover stony loam on account of its distinct topography, the cherty nature of the rock material, and its much lower agricultural value. Except for those areas containing high-grade limestone deposits, the price of the Wallpack stony loam seldom exceeds $8 to $10 an acre.

WALLPACK SHALE LOAM.

The surface soil of the Wallpack shale loam consists of a gray, shaly, silt loam about 7 inches deep, becoming a light ashy gray when dry. The subsoil to a depth of 20 inches or more is a pale yellow to a grayish yellow silt loam when dry. The shale content, representing from 60 to 75 per cent of the soil mass, increases with depth, the rock fragments becoming larger until the bedrock is encountered at 20 to 36 inches. The high content of shale and silt makes the type one of the lightest in the area.

The Wallpack shale loam is found exclusively in Sussex County west of Kittatinny Mountain on Wallpack Ridge. It occurs principally on the top of the ridge in areas where the soil is shallow.

This type is mainly residual although modified slightly by glaciation. Like the shale types of other series, the Wallpack shale loam would probably be improved by applications of lime.

General farming is the predominating form of agriculture and fair yields of corn and rye are secured. A large part of this type is neglected and overrun by scrubby growths consisting of sumac, elder, and young trees of other species.

On account of its broken topography, remote situation, and apparently low crop-producing capacity, due to thin soil, the type has a low value. Reforestation should make it more valuable than it is at present.

The following table shows the results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Wallpack shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25544	Soil	12.1	3.5	1.3	2.3	4.3	60.4	16.0
25545	Subsoil	12.6	4.8	1.6	2.2	4.2	47.0	27.4

WALLPACK FINE SANDY LOAM.

The surface soil of the Wallpack fine sandy loam consists of a brown, fine, sandy loam. The upper subsoil is a light-brown to yellowish-brown sandy loam somewhat heavier in texture. At 36 inches a still heavier material, approximating a loam in texture, is frequently encountered. Glacial bowlders distinct from the fine earth are found throughout the soil section.

This type is found on the west slope of Wallpack Ridge, the principal area extending as a narrow belt northwest and southwest from the vicinity of Hainesville. The topography is gently sloping,

which, combined with the rather porous texture of the soil, allows free drainage.

There is some doubt as to the origin of this type. The lower subsoil is generally ascribed to the weathering and decomposition of glacial till, while the upper part of the soil has been to a considerable extent modified by wind action.

Chestnut and oak cover a considerable part of the type, while a large part of it is utilized for pasturage. Much of the type has been neglected and consequently a thick growth of blackberry vines and brush has taken the place of sod.

On account of the distance to market special crops can hardly be grown successfully on the type, its best utilization being for pasturage. Potatoes and other vegetables do well, however, where grown.

This type is one of the lowest in value in the area, principally on account of its location and distance from market. It brings an average price of $10 an acre.

LACKAWANNA LOAM.

The soil of the Lackawanna loam consists of a brown to reddish-brown heavy loam from 6 to 9 inches deep, containing a large amount of silt. When dry the soil is gray with a distinct tinge of red. The subsoil is reddish-brown to Indian-red loam. Fragments of red shale of varying size are found throughout the soil profile. These are universally subangular, indicating relatively little glacial action. On account of its irregular topography greater difficulty is experienced in the cultivation of this soil than in case of some of the more level types.

The Lackawanna loam occupies an irregular belt on the western side of Kittatinny Mountain extending from the vicinity of Delaware Water Gap north to the State line. Smaller irregular areas are found in the Green Pond Mountain region. The type is frequently found associated with the Hoosic series in the lower situations and the higher lying areas are often bounded by the Kittatinny stony loam. Drainage is ordinarily well established. The soil owes its origin to the weathering of glacial till, which was largely derived from the red shale of the High Falls formation.

The native growth is almost entirely deciduous and consists of chestnut and oak. On account of its northwestern exposure and a consequent shorter growing season this type is looked upon with disfavor.

Buckwheat, grass for hay and pasturage, oats, and corn are the main crops. The Lackawanna loam is better suited to the general farming of this section than to special crops. It is probable that the greatest profits can be secured from this land by using it for pas-

turage, renovating the sod each year or as often as its condition requires. During dry seasons the pasturage on this type suffers from lack of moisture and frequently the sod is ruined. These vacant places are taken by "five-finger" and sorrel, which greatly impair the pastures.

Land values for the type are comparatively low because of the distance to market and also the shallowness of the soil. From $10 to $20 an acre is a fair valuation under present conditions.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Lackawanna loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25541	Soil	4.8	6.8	6.1	18.2	19.1	36.1	8.7
25542	Subsoil	6.2	8.2	6.4	16.0	16.7	33.2	13.3

LACKAWANNA STONY LOAM.

The Lackawanna stony loam consists of a slightly friable, brown to reddish-brown loam from 5 to 8 inches deep, grading in the subsoil into a yellowish brown or Indian red. This variation in color is governed by the depth of glacial till and the proportion of materials derived from rocks other than the one underlying the type.

The type occupies the northwest slopes of the Kittatinny Mountain, extending in almost an unbroken belt from the vicinity of Culvers Gap to the northern boundary of the area. The topography is gently to steeply sloping and the drainage is well established.

This soil is derived from the weathering of glacial till composed largely of materials from the underlying High Falls red shale and sandstone. With this shale material has been mixed a considerable quantity of conglomerate and sandstone from Wallpack Ridge and the Kittatinny Mountain. As a result the type is very stony. This fact, in conjunction with the high elevation and remote location, has retarded its development for farming.

At the present time there is practically none of the Lackawanna stony loam under cultivation, the whole area being covered with chestnut and oak forest which supplies fence posts and crossties.

This soil offers the best opportunity in the area for systematic forestry, since it is unsuited for any agricultural use except possibly as pasture. The value of the land without standing timber is about $8 an acre.

DOVER LOAM.

The Dover loam consists of a yellowish-brown to grayish-yellow, friable loam, from 6 to 10 inches deep. The subsoil is a yellow to yellowish-brown loam with a relatively high content of sand. Over the shallower areas a reddish color is noticeable, the material approximating that of residual origin. Mottlings of dark yellow are sometimes found in the lower portion of the subsoil.

The Dover loam is found exclusively in that part of the Kittatinny Valley underlain by the Kittatinny and Franklin (blue and white) limestones. These limestones also underlie the Dover stony loam. The loam is mapped in areas where the soil mantle is heavier and the stone content less than in case of the stony loam.

The topography is generally gently rolling, in few cases being either level or steep. These undulations are sufficiently pronounced to give excellent drainage.

The soil is derived largely from the weathering of the till composed largely of limestone material. It is one of the most productive soils of the area. In some cases the lower subsoil shows traces of residual origin. Limestone bowlders are found scattered over the surface of the type in varying quantities. Shale fragments are also found in that part of the limestone section south or southwest of the Dutchess soils, although the soil in such cases is characteristic of the Dover series.

The native vegetation is frequently of red cedar, although it does not grow as thickly here as on the stony loam. Of the deciduous species, hickory, oak, and chestnut predominate. The greater part of the type has been cleared and put under cultivation.

Corn, wheat, and oats are the chief crops on the Dover loam. Little rye is grown. Corn yields from 40 to 75 bushels per acre, with an average of 50; oats produce 20 to 40 bushels; wheat 15 to 28 bushels, with an average of 20. Hay does well, timothy yielding from 1 to 2 tons to the acre. Clover grows more successfully on this type than on any other in the area.

Potatoes are grown successfully. Some apple orchards are found on this soil, and when properly cared for give good yields.

Though derived from limestone soil, applications of lime should be made from time to time, particularly if leguminous crops are to be grown.

This type is the best upland soil in the area, which is shown not only by the estimated yields of crops but also by the character of the improvements, which indicate more successful farming than is seen on many of the soil types previously described. The price of land of this type is from $5 to $10 an acre more than that of the other members of this series, which have a similar location. The only disadvantage is the occasional outcrop rock, which somewhat hinders cultivation.

Dover loam, light phase.—The Dover loam, light phase, consists of a dark-brown, friable loam about 8 inches deep underlain by a yellowish-brown loam becoming lighter with depth. Fragments of limestone and gneiss are found throughout the soil section, but not ordinarily in quantities sufficient to hinder cultivation.

The light phase of the Dover loam is found exclusively in the Vernon Valley and in the eastern part of the Kittatinny Valley, in the vicinity of Franklin Furnace. It occupies gently rolling hills. Drainage is good.

This phase is derived principally from till of limestone material redeposited over practically the same formation. Near Hamburg and McAfee the type approximates the Gloucester loam, but otherwise it is quite distinct from the other soils of the area.

On account of its location and high agricultural value the Dover loam, light phase, is practically all under cultivation. Corn gives yields of 40 to 60 bushels per acre; oats, 30 to 35 bushels; rye, 15 to 20 bushels; wheat an average of about 20 bushels. Peach growing is carried on more extensively on this soil than on any other in this section of the area. The trees grow well and produce an excellent quality of fruit. Apples doubtless could be grown successfully. Grass yields well, but not quite as heavily as on the Dover silt loam.

The need of maintaining organic matter in this soil is as great as in case of other upland types of the area. Lime has been found beneficial, even though this is considered limestone soil. With proper preparation and inoculation of the seed bed there is little doubt that alfalfa would succeed on this phase.

The value of the Dover loam, light phase, is as high as any of the upland types in the Kittatinny Valley, the range being from $40 to $75 an acre. Farms containing areas of this soil are considered especially valuable.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil of the Dover loam:

Mechanical analyses of Dover loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23200	Soil	2.5	4.4	5.0	14.6	13.7	45.6	14.3
23201	Subsoil	2.1	3.6	3.8	10.4	11.1	46.2	22.4

DOVER FINE SANDY LOAM.

The Dover fine sandy loam consists of a brown to grayish-brown, friable, fine, sandy loam from 6 to 8 inches deep, underlain by a yellow to yellowish-brown, fine sand to fine, sandy loam becoming

decidedly heavier at a depth of 30 inches. The loam subsoil in this case consists of residual material. The surface soil is marked by an absence of sand of the coarser grades.

The Dover fine sandy loam is of rather limited extent. Several small areas are found in the vicinity of Quaker Church and northwest and southwest of Hamburg. In the vicinity of Monroe there is an area of considerable size representing a rather light phase of the type.

The topography is greatly rolling. This feature combined with the porous texture of the soil assures good drainage.

The Dover fine sandy loam is derived mainly from glacial till, coming from the blue limestone of Kittatinny Valley.

Practically all of the type is cleared and under cultivation, general farming and dairying being the prevailing forms of agriculture. Corn, wheat, oats, and grass for hay and pasturage are the principal crops. Corn yields from 30 to 60 bushels per acre, wheat from 15 to 25 bushels, with an average of 18 bushels, and oats an average of 25 bushels per acre. The open texture of the soil does not favor the conservation of soil moisture and the type is apt to be somewhat droughty, with consequent injury to crops, particularly in cases where the organic matter is allowed to become depleted. Special truck crops, such as asparagus, potatoes, and garden vegetables could be grown on this type, as it is one of the earliest soils in the area.

Land values for this type depend almost entirely on the soils with which it is associated. It is a minor type and of limited extent and no single tracts forming a farm have been reported in the area.

DOVER STONY LOAM.

The surface soil of the Dover stony loam consists of a friable, grayish-brown to brown loam to silt loam about 7 inches deep, thickly strewn with bowlders of varying size. The subsoil varies from a yellowish-brown to yellow, silty loam to silt loam, the texture changing with depth, as the result of increasing quantities of sand of the finer grades. In some cases there is a large content of silt and clay making the subsoil distinctly heavier than the surface soil.

In many parts of the type outcrops of gray to dark-blue limestone are numerous, giving the type a rough and rugged appearance. The intervening areas are often cultivated, the soil being productive.

The Dover stony loam occupies sections of the area in which limestone belts occur.

The surface varies from level to gently rolling with occasional hillocks of very steep, broken land. Frequent outcrops of the limestone give the type a general knobby topography. The drainage is good.

The type is derived from residual material and glacial till, the former coming chiefly from the Kittatinny (blue) limestone, although some areas, mapped as this type, are derived from the Franklin or white limestone. In some cases there is a thin layer of glacial till underlain by reddish to reddish-brown residual material.

A characteristic growth is the red cedar, which takes possession of every possible foothold. In many cases trees from 10 to 15 feet high grow out of the crevices of the rocks. The other, but not so numerous, forest trees are of the deciduous varieties, hickory being the most common.

The type is best adapted to pasturage. The large amount of rock outcrop makes cultivation impracticable on account of the difficulty in using farm machinery. The shallower areas, though very droughty, support a rich growth of succulent grass, which renews itself after every period of precipitation, offering good pasturage.

Some small areas of this type are so located as to allow cultivation, and where the soil is not too stony good crops of wheat and corn are secured. In fact, any crop planted is almost certain to thrive.

Where the land has been neglected blackberry bushes grow up rapidly, making dense, almost impassable thickets. This does not happen as a rule, as the type is too highly valued as pasture. Although a limestone soil, the type would doubtless be improved by the application of lime. The value of this type far exceeds any value one would suppose could be placed on such soil. In some cases it has a value as high as $40 an acre, and there are instances on record where the value was placed as high as $50.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Dover stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
21597	Soil	2.3	3.9	4.6	14.5	10.4	52.6	11.2
21598	Subsoil	2.6	5.1	4.9	16.1	14.5	42.1	14.6

HOOSIC LOAM.

The surface soil of the Hoosic loam consists of a light-brown to brown loam of variable texture, from 7 to 10 inches deep, averaging about 8. The subsoil is a sandy loam, the content of sand and gravel increasing with depth until at 30 inches a yellowish-brown to reddish-yellow, light, sandy, gravelly loam or sandy gravel is encountered. The sandy gravelly material varies in color, in some cases being quite

dark. This color of the lower subsoil is an indication of the presence of slate or shale rocks.

This type is found in small tracts on level areas widely distributed and generally associated with other members of the same series. Like them it occurs on moraines, kames, kame terraces, glacial deltas, and other valley deposits, but only on their more level portions. Where it occurs on moraines it is more or less stony, but otherwise is generally free from cobbles or bowlders. Gravel is scattered over the surface in varied amounts, though not usually in sufficient quantities to hinder cultivation, and at no time exceeding 10 per cent of the soil mass.

The type is of minor extent, but recognized as a very good soil. All of it has been cleared and utilized for the growing of general farm crops. It is not used for special crops, or recognized to have any special crop adaptation. It is planted to such staple crops as corn, grain, and grass. Areas favorably located may be used for peaches, though at present little attention is paid to this crop. The Hoosic loam is of greater value than the sandy loam or gravelly loam of the series. On account of its closer texture and greater depth, it has a higher moisture-retaining capacity, making it more able to carry crops through the season than the other types, which are likely to be droughty. The depth of the soil material is also greater in most cases than in the other types of the series.

Grass gives yields of from three-fourths ton to 1½ tons per acre. Corn does very well, and matures earlier than on the Dutchess or Dover soils. The type is also especially valued because of the ease of cultivation afforded by its relatively level surface and small quantity of stones. Potatoes are grown successfully on this type.

The Hoosic loam is greatly benefited by the application of lime and manure, and with such additions any of the cultivated crops can be grown successfully. It is usually sold at $35 to $50 an acre.

HOOSIC SANDY LOAM.

The surface soil of the Hoosic sandy loam consists of a friable light-brown to brown sandy loam, from 8 to 10 inches deep, containing varying amounts of coarse sand and gravel. The subsoil is a light-brown to yellowish-brown sandy loam, continuing to a depth of 15 inches and grading below into a yellow to yellowish-brown stratified sand or gravel, the gravel content increasing with depth. Below 3 feet a coarse gravel is encountered, resting upon water-deposited beds of stone. The type is practically free from large stones on the surface or near enough to the surface to interfere with cultivation. It is one of the most easily cultivated soils in the area.

The type is found in small bodies throughout the area, occupying portions of reworked glacial terraces bordering streams and drainage-

ways. These are variously known as kames, kame terraces, glacial deltas, and recessional moraines. The principal body of this type is found on the Germany Flats, in the central part of Sussex County. The topography is level to very gently rolling.

The soil is a reworked glacial deposit composed of a heterogeneous mass of rock fragments coming mainly from the different rocks found in the area. The character of the rock materials in the different areas varies, however, being influenced by the proximity of the underlying parent rocks, which may be limestone, slate, or shale. It is probable that the type, as found in the eastern part of the area, is somewhat lighter than where the underlying rock material is of finer texture than the gneisses. However, the soil has very nearly the same physical properties wherever found, since the original material was heterogeneous, and has weathered down to a similar physical condition.

The level topography and absence of large rocks favor the extensive utilization of this type. It is practically all under cultivation. The porous subsoil and sandy loam soil make the type somewhat droughty and inclined to leach unless kept well supplied with organic matter.

The general farm crops are grown, except grass, as the soil is leachy and not suited to this crop. Corn yields from 25 to 70 bushels per acre, oats from 20 to 35 bushels, and potatoes, to which the type is especially adapted, from 75 to 150 bushels. This soil could easily be made to yield well if used for special crops, such as potatoes and some of the late staple truck crops. Hay yields from three-fourths ton to 1 ton per acre.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Hoosic sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23198	Soil	2.6	12.1	11.2	22.6	7.1	31.2	13.0
23199	Subsoil	8.0	22.8	13.0	13.4	9.4	18.6	14.4

HOOSIC GRAVELLY LOAM.

The Hoosic gravelly loam consists of a light-brown to brown gravelly loam from 6 to 8 inches deep. The subsoil is a yellowish-brown, gravelly loam, becoming more sandy with depth and grading at 20 inches into a gravelly, sandy loam, gravelly sand, or gravel. A slight reddish tint is sometimes noticed at a depth of 12 inches. The gravel consists of waterworn and rounded material derived from a variety of rocks. It occurs on the slopes and steeper portions of

the type where erosion has been active, carrying away the fine earth and leaving the coarser rock fragments. In such places the soil is a gravelly, sandy loam, but on account of its slight extent it was impracticable to make a separation.

The type is derived from reworked glacial deposits represented by kames, kame terraces, parts of moraines, and the steeper portions of the valley trains and glacial deltas. The lower subsoils are frequently composed of coarse gravel, pebbles, and stones, varying in size from 1 to several inches. The series as a whole is free from large bowlders. In extremely few cases are there any of considerable size found in the surface of this type.

The Hoosic gravelly loam is considered a droughty soil, the subsoil being extremely porous. On the steeper and more sandy phases the productivity is very low, such tracts being considered practically worthless. The more level areas are used for the general farm crops such as corn, hay, and pasture. This soil is one of the most easily cultivated types in the area and gives good results where the moisture supply is adequate. It is especially suited to the growing of potatoes and staple truck crops; also small fruits and peaches, which, in a few instances, are being grown successfully and at one time constituted an important crop. In many cases it would seem advisable to plant these special crops and practice a more intensive line of farming on this type, as well as on the other members of the series. Grass sods last but a short time, the fields being taken possession of by weeds. Yearly applications of manure are necessary to maintain the organic matter content and fertility of this type.

The Hoosic gravelly loam occurs practically in all parts of the area, except in the immediate valley of the Delaware River, where the terrace soils all belong in the Chenango series. Generally, however, they are found near the present drainage systems or at the border of their bottom lands. Portions of the area mapped 2 miles east of Montague represent a distinctly morainic phase of the type.

The topography varies from nearly level to rolling and broken. In the level tracts there are frequent kettle-hole depressions; these impair the value of the land for agriculture.

Where lime and manure are applied, good results are secured with any of the crops grown. In a few cases orchards have been planted, but the type is generally utilized for the general farm crops and pasturage. In the adaptation of this soil to crops it should be utilized more extensively for special crops and less for general farming.

CHENANGO LOAM.

The surface soil of the Chenango loam consists of a brown friable loam from 8 to 15 inches deep, carrying a relatively high content of fine and very fine sand. The subsoil is practically the same in tex-

ture, but slightly lighter in color than the surface soil. Like most water-deposited soils, the texture is more or less variable. The 3-foot section is practically free from gravel and stones, making cultivation easy. The surface and subsoil are sufficiently heavy to retain the moisture necessary for crop development.

The type is derived from the deposition of river sediments when the Delaware River flowed at levels from 20 to 60 feet higher than at present. On account of its fine texture it is likely that a large part of the soil mass was deposited at times when there was very little current or by partially stagnant water.

Its level surface and freedom from stone makes this soil one of the most desirable types in the county. From the standpoint of natural fertility it probably is not as durable as some of the other types, but on account of the much greater ease of cultivation it is highly valued. It is utilized for the growing of the general farm crops. Grass does well where seeded frequently and treated with fertilizers and manures. Corn yields from 60 to 80 bushels per acre, wheat and rye from 18 to 25, and oats about 40 bushels per acre. Grass and clover yield from 1 to 2 tons per acre. Lime in connection with manure gives excellent results on this soil. Potatoes do exceptionally well, yields of 150 to 200 bushels being secured with proper cultivation and attention. This is one of the best potato soils in the county. At one time tobacco was successfully grown on one of the areas of the type. It is said that the crop did well and that the grade was good. The only drawback to this soil, as in the case of the other members of the series, is its remoteness from railroad transportation facilities, making such bulky crops as potatoes, truck, and small fruit for which the soil is admirably suited, unprofitable because of the long haul over rather rough roads.

Land of this type is valued at $30 to $75 an acre, depending on the location. In some cases where it is possible to haul produce to Port Jervis much higher values are obtained.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Chenango loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
24249	Soil	0.0	0.2	0.5	24.4	22.1	43.5	9.4
24250	Subsoil	.1	.0	.5	15.1	27.7	45.6	10.7

CHENANGO SILT LOAM.

The surface soil of the Chenango silt loam consists of a smooth, friable, light-brown silt loam to heavy silty loam from 8 to 12 inches deep, containing a relatively large proportion of fine sand. To a depth of 20 inches the subsoil is lighter brown to yellow and about the same texture as the surface soil, becoming lighter in texture below this point. Coarser material is found at a depth of several feet. The type, as a rule, is free from stones or stony materials which interfere with cultivation.

It is a terrace soil of small extent in this region, only three areas having been mapped. Where present it occurs as nearly level tracts, 20 to 40 feet above the present stream.

The Chenango silt loam is one of the most valuable soils in the area. Corn yields from 50 to 90 bushels per acre, wheat and rye from 20 to 25 bushels, and oats from 40 to 60 bushels. Grass does better on this type than on any of the other members of the series, yielding from 1¼ to 2 tons of hay per acre. Applications of manure and lime give good results, as in many places the soil seems to be slightly acid. The addition of organic manure also benefits the structure of the type and increases its power to retain moisture.

Land values range from $40 to $60 an acre, depending upon location and improvements.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Chenango silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25531	Soil	0.1	0.3	2.0	11.4	24.4	52.2	9.4
25532	Subsoil	.1	.5	2.9	15.5	22.7	47.6	10.6

CHENANGO FINE SANDY LOAM.

The Chenango fine sandy loam consists of a dark-brown to brown fine sandy loam, loose and friable and varying in texture from light to heavy. The subsoil is a light-brown to slightly reddish or chocolate brown, becoming slightly more compact with depth, until at 20 inches it grades into a sandy loam containing somewhat more clay than the surface soil. Over areas of slight elevation a small content of gravel is sometimes noted in the subsoil at a depth of 30 inches. Such areas are less valuable than those where the fine sandy material has a greater depth.

The type occupies terraces from 20 to 60 feet above the Delaware River, extending back not more than a mile from the river bank. The topography is prevailingly level, except for slight depressions where erosion has been active. Drainage is uniformly good and in some cases excessive, the type suffering from lack of moisture over such areas during the growing season.

The Chenango fine sandy loam is all cleared and practically all under cultivation to the general farm crops of the area. Truck crops are extensively grown in the extreme northern part, strawberries doing exceptionally well. Of the general farm crops corn yields 50 bushels per acre, oats from 25 to 35 bushels, and hay from one-half to 1 ton per acre, with greater yields in wet seasons. Asparagus would do well on this type, though very little of it is grown at the present time. Manure and fertilizer are used on this type quite extensively, especially for the truck crops. In the production of general farm crops applications of lime in connection with manure give excellent results. Alfalfa doubtless can be grown on this type where the seed-bed is properly prepared by the use of lime and organic matter and the soil is inoculated.

The value of the type varies widely, depending entirely upon proximity to markets. As a truck soil it is doubtful whether there is any type in the area which is as well suited to the industry as the Chenango fine sandy loam. For general farming the type has relatively low value, being worth from $15 to $30 an acre for this class of crops. Where used for trucking as high as $75 an acre is sometimes paid for it.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Chenango fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25537	Soil	1.3	10.3	11.4	29.4	18.0	24.3	5.6
25538	Subsoil	1.7	11.3	12.9	30.1	18.1	18.5	7.3

CHENANGO FINE SAND.

The surface soil of the Chenango fine sand consists of a loose, friable, brown to dark-brown, fine sand from 8 to 10 inches deep, sometimes showing a reddish tinge. The subsoil is a light-brown to slightly reddish or yellowish brown rather loamy fine sand slightly heavier than the surface soil in the upper portion, but becoming lighter in color and texture below 18 inches. In the lower portion the material is distinctly a fine sand.

The type occupies portions of the terraces along the Delaware River next the river bank. As a rule it is found associated with the other members of the Chenango series. The type is of sedimentary origin, deposited by the river during times of overflow, which in some cases has been modified by wind action. It is found at elevations of from 20 to 60 feet above the present river level. Portions of the type give evidence of a more recent formation, being underlain by heavier soils at a depth of several feet. The topography is generally level to gently sloping.

The Chenango fine sand is practically all cleared. Its utilization is somewhat variable under present conditions, as it is considered somewhat droughty. It is recognized to be an excellent early truck soil for all of this class of crops. Asparagus and garden crops do especially well. Strawberries, dewberries, and blackberries all give satisfactory yields if the moisture supply is maintained. Melons do especially well on this soil, giving fruit of excellent quality and good yields. At the present time much of the type is used for corn, buckwheat, and oats, but on account of its open, porous nature, general farming on this type of soil can hardly be considered a success. In the production of either truck or cereal crops, maintenance of the organic matter in the soil is an essential factor. Applications of manure should be made frequently, and when supplemented by fertilizers they give excellent results. The plowing under of green crops on soils of this series is an admirable practice, especially in the production of truck crops. During the fall and winter the Chenango fine sand, like the other members of this series, but especially the coarser soils, needs protection from winds. If covered with some grain crop during this period, much of the damage from this source can be avoided. Rye sown either between corn or after the crop is cut will make a sufficient growth to aid materially in the protection of this type. Strawberries do well if mulched with straw, as this will protect the plants during the winter and also retain moisture during the following fruiting season when there is danger of drought. On account of its lower moisture-retaining capacity and the general farming practiced in most of the section where it occurs, this type is not considered to be a soil of any great value.

With an improvement in the transportation facilities of this part of the area, a more intensive system of trucking can be carried on, greatly enhancing the value of this type. At the present time it is held at prices ranging from $15 to $30 per acre, depending upon location with regard to market.

The table following shows results of mechanical analyses of samples of soil and subsoil of type.

Mechanical analyses of Chenango fine sand.

Number	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25539	Soil	0.1	1.3	6.6	60.5	20.9	8.3	2.1
25540	Subsoil	.0	.7	5.2	52.2	23.3	15.1	3.6

CHENANGO SANDY LOAM.

The surface soil of the Chenango sandy loam consists of a loose, friable, brown or grayish-brown, light, sandy loam, about 8 inches deep with a marked content of sand of the coarse and medium grades. The subsoil is a yellow to yellowish-brown, somewhat incoherant, sandy loam of rather light texture. There is a decided content of silt and clay in the surface soil which decreases with depth until at 3 feet the lower subsoil is a loamy sand or very light, sandy loam. Very few pebbles or other stone fragments are found in the soil mass of this type.

The Chenango sandy loam is found as a terrace soil in the Delaware Valley, occupying level to gently sloping sections between the river and upland types, or elevations varying from 20 to 70 feet above the river and closely associated with the other types of this series.

The type is derived from stream sediments deposited by the Delaware River, but little of it is subject to inundation under present conditions. In extent the type is of minor importance, though agriculturally it could be made valuable by improving the transportation facilities.

Drainage is well established, and the type warms up early in the spring. It is easily tilled and well adapted to the production of small fruits and early truck crops, which mature rapidly and to better advantage than on the heavier types of soil in this same region. Melons and potatoes can also be grown successfully, while asparagus of good quality and early for this section can be produced.

Like the fine, sandy loam members of this series, the best results can be secured only by maintaining the supply of humus, either by the application of manure or plowing under green crops. Applications of fertilizers may be used to supplement these additions of organic matter. The utilization of this soil for the production of melons and early truck crops is especially recommended. Strawberries, dewberries, and blackberries can all be grown and where a market is available, would prove profitable crops. Alfalfa could readily be produced on much of this type with the proper preparation of the land. For success with this crop the soils must be limed and inoculated after a good seed bed has been secured. Under cultivation

the supply of organic matter is soon depleted, necessitating large applications of organic manure to secure maximum yields for crops.

Land values for this type vary from $25 to $100 an acre, depending upon location with reference to transportation facilities.

CHENANGO SAND.

The surface soil of the Chenango sand consists of a brown to yellowish-brown sand from 5 to 8 inches deep, containing small quantities of silt and low in organic matter. The subsoil is a yellow to yellowish-brown sand of about the same texture as the surface soil except for the absence of the organic matter. Strata of heavier soils, such as loam and fine, sandy loam occur at a depth of several feet, but have little or no effect on the overlying soil. The sand grains of both soil and subsoil are rounded and very little gravel or coarse material is incorporated in the soil profile.

Several small areas of the Chenango sand are found along the Delaware River in various sections where this series occurs. The surface takes the form of shallow dunes from 30 to 70 feet above the normal elevation of the Delaware River. The light texture and loose structure of this type make the retention of moisture almost impossible during periods of drought.

Although originally a river deposit, in its present position and topography the soil is largely due to wind action, as is shown by its dunelike contours.

The native vegetation consists of stunted pine and scrub oak, with a scant growth of sand grass intermingled with blackberry and dewberry vines.

Where a sufficient moisture content can be maintained the Chenango sand is adapted to the production of blackberries and dewberries. Early truck crops could also be raised on this type with the addition of sufficient organic matter to retain the moisture supply, though it is doubtful whether the facilities for marketing products would make this expense profitable. At present it is not used for agricultural purposes, except where a few fields of buckwheat have been planted. This crop gives light yields. The agricultural value is lower than that of any type found in the area, and in some cases it is not considered to be worth anything for agricultural purposes. Land values are low, probably not exceeding $5 an acre.

FOX GRAVELLY LOAM.

The Fox gravelly loam consists of a brown to dark-brown, gravelly loam about 10 inches deep, becoming lighter in texture and color until at 24 to 30 inches it grades into a gravelly sandy loam or gravelly sand. The lower subsoil becomes decidedly lighter in texture,

and at several feet is composed mainly of gravelly material consisting of waterworn limestone fragments. Unlike the Hoosic gravelly loam, the rock fragments are present in smaller quantities on the surface.

The largest area of the Fox gravelly loam is found in the vicinity of Springdale and Andover. It occupies level areas of stratified glacial drift in limestone valleys. Some depressions and broken sections occur, giving rise to a type of much less value agriculturally than the Fox gravelly loam. These have been classed with the Hoosic series. Numerous outcrops of limestone rock are found which are classed with the Dover stony loam. Drainage is at all times adequate.

Practically all of the type is under cultivation and highly valued on account of its crop-producing power, ranking higher in this respect than the Hoosic gravelly loam. The latter type is often inclined to be lighter in texture and to have a more porous subsoil.

Rye and wheat both produce good crops, averaging about 18 bushels to the acre. Oats produce about 30 bushels and corn from 40 to 70 bushels, depending on the care given the crop. Grass, while giving fair yields, does not do so well as on some of the heavier types. From 1 ton to 1½ tons of hay are considered a fair yield. Potatoes should be grown more extensively.

On account of its location, as well as its exceptionally high productivity, this type is probably the most valuable of any in the area under present conditions. Values range from $60 to $100 an acre, and in some cases even the last figure is considered too low.

GENESEE LOAM.

The surface soil of the Genesee loam consists of a heavy brown to dark-brown fine sandy loam to loam from 8 to 12 inches deep. The subsoil is similar in texture and color to the soil, showing mottlings of gray and yellow in areas of deficient drainage and aeration.

The type is of alluvial origin, representing depositions by the smaller streams of the area during periods of high water. The variation in texture throughout the type is due to the stratification resulting from continued depositions at recurring intervals of high water.

This type is a bottom-land soil and subject to inundation during periods of extremely high water. On account of inundation it is not usually plowed. However, where cultivated it proves productive and easily handled. Corn gives good yields, especially the silage varieties, but the season is frequently too short to allow the grain to mature. Practically all of the type is used for mowing and pasturage. Excellent yields of the native wild grasses are secured, and where properly drained and seeded timothy and other cultivated grasses give good results. The poorly drained sections are used for pasturage.

During dry seasons this soil is especially prized because of its good pasturage when the uplands are completely dry.

The Genesee loam is found along the better-drained stream bottoms scattered throughout the area. The type is of limited extent and not of great importance agriculturally, though considered one of the best grass soils in the area.

The following table shows results of mechanical analyses of samples of soil and subsoil of this type:

Mechanical analyses of Genesee loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23196	Soil	0.8	2.3	3.4	14.3	28.8	30.9	19.3
23197	Subsoil	1.6	4.2	6.5	28.9	27.4	18.7	12.9

PAPAKATING SILT LOAM.

The Papakating silt loam is a black to dark-drab, heavy, silty loam to silty clay, slightly gray at a depth of 7 inches. The subsoil is a gray and yellow, heavy, silt loam to clay loam. The color and texture are characteristic of the soil, which is decidedly heavier than the other soils found in the county. The lower subsoil is somewhat more variable in texture and slightly more sandy, being often a fine sandy clay.

The Papakating silt loam is a bottom-land and poorly drained type suffering from excessive moisture, especially in the spring and summer, making it cold, and late. It also shows traces of acidity and is little used for cultivated crops. Attempts to grow corn have proved fruitless, owing to these conditions.

This soil is found in the valleys of the principal streams and in what were probably, at one time, old, glacial lake bottoms. It also occurs in the low areas of the uplands. It generally occurs a few feet above stream levels and is subject to inundation for short periods, especially during spring freshets. This type as a whole is closely related to the Genesee loam, which is also a bottom soil. The latter type, however, is found on the better-drained sections of the bottom lands, while the Papakating silt loam occupies the lower and poorly drained sections.

This type is an alluvial soil derived from sediment deposited during periods of overflow of the larger streams in old glacial lake bottoms and from material which has been eroded from the surrounding uplands and has more the nature of colluvial material. The latter condition, however, occurs only on small areas on some of the uplands.

Practically all of this type is cleared and allowed to support its native vegetation, which consists of a heavy growth of water-loving grasses of the coarse reed varieties, which have a tendency to grow as bogs on the lower poorly drained lands, and as finer wild grasses in the better-drained sections of the type. The soil is well adapted to grass and pasture. Grass yields vary considerably, especially in quality, which depends to a great extent on the drainage. The average yield is about 1½ tons to the acre.

The Papakating silt loam could be made one of the most valuable forage-producing types in the area if the drainage could be so improved as to allow the excessive moisture to escape readily, and the structure improved by the use of lime. The cultivated grasses could then be gradually introduced with good results. The general practice is to allow the type to stand idle except for such grasses as can be gathered.

Farm lands containing areas of this type are not influenced in value by this type, as it can be used for pasture during dry seasons.

WALLKILL SILTY CLAY LOAM.

The surface soil of the Wallkill silty clay loam consists of a compact, dark-drab, silt loam to clay about 9 inches deep, of fairly friable structure. The subsoil from 9 to 36 inches is usually a black muck resting upon a deposit of dark-brown organic matter. The texture of this type as a whole is the heaviest of any found in the area.

The type is found in several sections in the northern part of the Wallkill Valley and in the Black Creek section in the neighborhood of Vernon.

The topography is practically level, the type being found but a few feet above the stream floors and subject to inundation during spring freshets and at periods of extremely heavy rain.

The type owes its origin to an accumulation of organic matter underlying to a depth of several inches the fine-earth materials washed from the adjoining uplands. It is derived from both colluvial and alluvial materials. In some cases the areas of this soil are being increased by fresh accretions of earth during recurring inundations.

The native growth of the type consists principally of maple, though most of it is cleared and utilized for grass and pasture. In some cases better crops of the lighter grades of hay could be secured by opening ditches and allowing the more rapid escape of excess water. Hay crops of 2 tons per acre are not unusual, and in many cases even greater yields are reported. As a pasture land, especially during dry seasons, this soil is the best in the area, the grass deriving its moisture supply from the saturated subsoil, while the surface

soil is dry enough to form a support for stock and harvesting machinery. For grass and pasture the type is worth about $40 an acre, where well drained. It is not used for cultivated crops, the heavy surface soil combined with the saturated subsoil being unsuitable for grain.

MUCK.

Muck as found in this area is composed of a black organic deposit combined with a rather small amount of mineral matter. When wet or saturated, it has an inky black color, but when partly dry it is a grayish black. The mineral content is variable, but usually low, the greater part of the mass being composed of organic matter. The subsoil, which is usually found at a depth of 12 inches, is a brown to dark-brown mass of partially decomposed organic matter. Muck is found in small areas scattered over the entire survey. Numerous areas of this type are found in the northern part of the Wallkill Valley on what is known as the "drowned" lands. This area connects with a large tract of the same soil found in the adjoining part of the Wallkill Valley in New York State, which is so intensively developed in that section of Orange County. Clark Creek, which is a tributary of the Wallkill, forms the outlet from another large tract. At the head of Paulins Kill, at Newton, a large area occurs, with a second in the same drainage basin at Lafayette. Other areas of this type are found in the Highland district, southwest of Sparta, north of Macopin Lake and at Moe. In the southern part of the Kittatinny Valley, south of Johnsonburg, small areas occur which project north from the south. These connect with the Great Meadow district, in which section large areas of this type are utilized for the growing of staple truck crops.

Muck owes its origin to the accumulation of organic matter which has probably been collecting since the blocking of the waterways by glacial deposits.

The native vegetation consists of reeds and coarse water-loving grasses, although in some cases a few maples and white cedars have encroached upon the type.

This type is particularly well adapted to the growing of intensively cultivated crops, such as onions, lettuce, celery, and cabbage. The White Globe onions do especially well, followed closely by the Yellow Globe. Large yields of celery of an excellent quality are secured. In some cases where this type has been reclaimed it is used for pasture in conjunction with the uplands during periods of protracted drought. It is only during such a time that it is possible to allow stock to pasture on it because of its miry nature. Some of the small areas could be drained and improved at the expense of a very little labor. In the case of the larger tracts, the problem is more difficult

and requires extensive engineering work and a measure of cooperation among the different landowners.

The value of this soil varies from $10 to $100 an acre, some cultivated sections commanding an even higher figure.

MEADOW.

Meadow, as mapped in the area, consists of low-lying areas of widely varying texture. The surface ranges from a muck soil to heavy clay loam or clay, in some cases overlying deposits of coarse sand. In the case of the muck areas, this material is not of sufficient depth even if cleared of bogs and stones to use for the growing of special crops. The whole of the stream bottoms mapped as this type have compact strata of moisture-retaining subsoils. The surface in many of the areas is boggy. The native grass is of the tussock variety, the plants being several inches to a foot above the real surface of the soil.

This type occurs in all parts of the area in small sections along streams, brooks, and near springs. Where found near springs the areas are frequently too small to map. In the Kittatinny Valley, especially in the neighborhood of Branchville, this type is composed of low lands which are continuously in a very wet, water-logged condition and have the surface strewn with rocks. The number of stones vary in different parts of the area, but are usually fairly numerous.

On account of its position and the narrowness of the areas, combined with the varying texture of the soil, it is doubtful whether it would be an economical undertaking to clear this type and attempt to use it for any other purpose than pasturage, to which it is best adapted and for which it is now utilized. In some cases the wild grasses are gathered and made into hay. Usually this has to be done by hand, as the clumps make it impossible to use a machine. It gives good yields of coarse forage, having little value compared with good clover hay.

As a rule this type is not regarded as decreasing the value of the farm to which it is attached, and, considering it as an indication of the proximity of water, it is a valuable asset. The area being a dairy section, such lands can be used to advantage, as they furnish a good supply of pasturage, especially in dry seasons.

The Meadow is to a great extent alluvial soil, though in some cases it may take the nature of colluvial material modified by weathering. The depth of this alluvial and colluvial material is not great, as is shown by the large bowlders which frequently dot the surface.

ROCK OUTCROP.

Only one extensive area was mapped as Rock outcrop. This occurs on the steep slopes of Kittatinny Mountain and along the top of the mountain, where it consists of a narrow, ridge-like crest. Out-

crops of rock occur in a great many places in the Kittatinny Valley, especially in areas closely associated with the Dover soils and in the areas of Rough stony land in the Highlands. They are too small in area, however, to be shown on the map.

WASTELAND.

The material classified as Wasteland consists of raw subsoil exposures such as extensive erosion scars, scars where the soil has been removed as the result of mining operations, either by rock blasting or hydraulic means, landslide scars, etc. Until weathering processes shall have had time to develop a surface zone of soil material supplied with humus and bacteria these areas are but sparingly capable of supporting plant life.

SUMMARY.

The Sussex area is situated in the extreme northern part of the State of New Jersey and includes practically all Sussex and parts of Warren, Morris, and Passaic Counties. It embraces an area of 788 square miles, or 504,320 acres. The topography varies from gently rolling to steep, broken, and mountainous, with elevations ranging from 180 to 1,809 feet.

The area is drained by three systems, the Delaware, Hudson, and Passaic. The section west of Kittatinny Mountain is drained by the Delaware River. Two tributaries of the Passaic River drain the eastern part of the Highlands. The Wallkill River and its tributaries drain the northern part of the area. The run-off here finds its way into the Hudson near Newburgh, N. Y.

The descendants of the early settlers form the bulk of the agricultural population of the area. Newton, in Sussex County, is the largest town, with 4,467 inhabitants. A number of trunk and branch railway lines give direct communication with New York City.

The climate is moderately cool in summer and the winters rather cold. The growing season varies in length from 137 to 161 days in different sections of the area. The mean annual precipitation is 43.99 inches, evenly distributed throughout the year, and averaging about 4 inches a month during the growing season. The mean annual snowfall is 3 feet with occasional snows as late as March.

The present type of agriculture consists mainly of dairying to supply milk for the New York market. In many cases dairy stock is brought in from other sections and large quantities of grain are shipped into the area annually. The crops, except truck, are for the most part fed on the farm. Much of the upland area and a large part of the land mapped as Meadow is used for the production of hay and for pasture.

Improved drainage would increase the value of large areas of land practically worthless under present conditions. A better rotation of crops and an improvement in cultural methods are needed. Farm labor is efficient but scarce.

Thirty-six soil types, including Muck, Rock outcrop, and Waste-land, were mapped in the area. The soils vary widely in texture and character, although the greater area is occupied by the loam class. The soils are of glacial, glacio-residual, lacustrine, and alluvial origin.

The upland soils fall into four main series with several minor series represented by one or two types only.

The Dutchess soils are found in the Kittatinny Valley and represent what are known locally as the slate and shale soils. Their cultivated area probably exceeds that of any other series found in the survey, although the different members vary widely in agricultural value. A loam, with a shaly loam phase, shale loam, and stony loam were mapped. The general farm crops, including hay, are grown with good results. The organic matter should be more carefully maintained by growing and plowing under leguminous crops. The loam member of the series is valued at $40 to $60 an acre and even higher, while the shaly loam phase brings $25 to $50, and the shale loam from $10 to $35 an acre. The stony loam is not cultivated and is utilized only for pasture.

The Dover soils, found in the limestone belt, though of small extent, are recognized as some of the most productive soils of the area.

Three types—a loam, with a light phase, a fine sandy loam, and stony loam—were mapped. The general farm crops are grown on all of these soils except the stony loam, which is too rough for cultivation except over very small tracts. The loam is one of the best of the cultivated upland types. Some peaches are grown on the light phase, which is held at prices ranging from $40 to $75 an acre. The sandy loam is of limited extent, but practically all cleared and under cultivation. It is somewhat droughty, but can be used for special truck crops such as asparagus and early garden vegetables, being one of the earliest types in the area. The stony loam supports a rich growth of grass which renews itself frequently and is much valued for grazing. Red cedar is a characteristic tree on this type. The land brings as high as $40 to $50 an acre.

The Gloucester or "gray rock" soils occupy the greater part of the Highland district of the area. These soils have a more rugged topography and lie at higher elevations than the other series. Four types were mapped—a loam with a silty phase, a sandy loam with a gravelly phase, a stony loam, and a stony sandy loam. Where cultivated the general farm crops are grown with fair to good yields. Some apples and peaches are produced on the lighter phases of the

loam. This member of the series is valued at $25 to $50 an acre. The sandy loam is of limited extent, most of it being found west of Briar Ridge. The better-drained areas are well adapted to peaches. The open, porous subsoil and soil make this a poor grass soil. Considerable buckwheat is grown with good results. This type is worth about $30 an acre. The stony loam supports a good growth of grass, which is usually grazed off, as the land is too rough and broken to permit the use of machinery. The topography is gently rolling to rolling, and much of the type has been acquired by the Newark Water Board to be reforested. The better-drained areas are suited to apples. The stony sandy loam is found in the Pochuck Mountains and the eastern part of the Highlands. With liberal applications of manure and lime it could be made to give good yields of the general farm crops. Peaches do well on this soil where protected from the San Jose scale. Apples do better on the heavier soils. Grass is grown on this type, but this crop does not withstand periods of drought.

Rough stony land is also mapped in the region occupied by the Gloucester soils. It is mostly in forest and held at $3 to $10 an acre. It is nonagricultural and best left with a forest cover.

The Hoosic soils comprise what are locally known as "gravel lands." The subsoils are gravelly and porous, making the members some of the earliest soils of the area and in many cases better suited to the production of special crops, such as early vegetables, and potatoes, than to general farm crops or pasturage. A loam, sandy loam, and gravelly loam were mapped. The loam member of the series sells for $35 to $50 an acre.

The Chenango soils occupy the Delaware River terraces and are the best trucking soils in the area. Their greatest handicap at present is their remote location from markets and transportation. Six types were separated and mapped—a loam, silt loam, fine sandy loam, fine sand, sandy loam, and sand. The sand is the least valuable of these types, being found mainly as dunes along the Delaware River. It is held approximately at $5 an acre. It is used only for berries and similar crops. The loam member is one of the best potato soils in the area, as high as 200 bushels of this crop being raised to the acre. It is considered worth from $35 to $75 an acre. The silt loam is used mainly for the general farm crops, and in some cases for clover. It is worth from $40 to $60 an acre. Where available for trucking the fine sandy loam brings about $75 an acre, but is mostly used for the general farm crops and worth from $15 to $30 an acre. The sandy loam ranges in price according to its use, which depends on location with reference to markets, from $25 to $100 an acre.

To the west of the Kittatinny Mountains occur the red shale lands embracing the Lackawanna series. The Wallpack soils include the

limestone lands of the Delaware Valley, and are distinguished from the calcareous Dover soils by their chert content. The Wallpack soils of the Wallpack Ridge contain more shale than slate, which is the predominating feature of the Dutchess series.

The other soils are of limited extent and confined to individual types. Where cultivated they are generally used for ordinary farm crops with fair to good results. A carefully selected crop rotation and a system of soil management looking to the maintenance of the humus content of the soil would benefit all of the types found in the survey.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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SOIL MAP
NEW JERSEY
SUSSEX AREA SHEET

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

GEOLOGICAL SURVEY OF NEW JERSEY.
HENRY B. KUMMEL, STATE GEOLOGIST.
NEW JERSEY AGRICULTURAL COLLEGE
EXPERIMENT STATION.
JACOB G. LIPMAN, DIRECTOR.

SOIL PROFILE
(3 feet deep)

- Dover loam: L / L
- Dutchess stony loam: Sl / Sl
- Dutchess shale loam: Sl / Sl
- Light phase: LI / LI
- Dover stony loam: L / Sl
- Dutchess loam: Sl / Sl
- Dover fine sandy loam: Fsl / Fsl
- Shaly phase: Sl / Sl
- Chenango sand: S / S
- Gloucester loam: L / L
- Chenango fine sand: Fs / Fs
- Gloucester silty loam: Sil / Sil
- Chenango loam: L / L / L / Grsl
- Silty phase: L / LI
- Chenango sandy loam: Hsl / Sl / S
- Gloucester stony sandy loam: Sl / Lsl
- Chenango fine sandy loam: Fsl / Hfsl / Grfsl
- Gloucester sandy loam: Sl / Lsl
- Chenango silt loam: Sil / Sil / LI / Grl
- Gravelly phase: Gsl / Hgrsl
- Lackawanna loam: L / L
- Wallpack stony loam: L / L
- Lackawanna stony loam: L / L
- Wallpack shale loam: Sil / Sil
- Culvers loam: L / Hl
- Wallpack fine sandy loam: Fsl / LI
- Culvers stony loam: Sil / Hl
- Wallpack silt loam: Sil / Sil
- Fox gravelly loam: Grl / Hgrsl / Hgrsl / Grsl
- Heavy subsoil phase: Sil / Sil
- Genesee loam: LI / Fsl
- Hoosic loam: L / Sil / Grsl
- Papakating silt loam: Sil / Hsil
- Hoosic gravelly loam: Grl / Grsl / Grs
- Wallkill silty clay loam: Sicl / Mu
- Hoosic sandy loam: Sl / Sl / S

LEGEND

L Loam
LI Light loam
Sil Silt loam
Fsl Fine sandy loam
S Sand
Fs Fine sand
Grsl Gravelly sandy loam
Hsl Heavy sandy loam
Sl Sandy loam
Hfsl Heavy fine sandy loam
Grfsl Gravelly fine sandy loam
Grl Gravelly loam
Hl Heavy loam
Hgrsl Heavy gravelly sandy loam
Hsil Heavy silt loam
Sicl Silty clay loam
Mu Muck
Lsl Light sandy loam

LEGEND

- Dover loam: Dl
- Dutchess stony loam: Dsl
- Dutchess shale loam: Dsh
- Light phase: Dl
- Dover stony loam: Ds
- Dutchess loam: D
- Dover fine sandy loam: Df
- Shaly phase: D
- Chenango sand: Cs
- Gloucester loam: Gl
- Chenango fine sand: CFs
- Silty phase: Gl
- Chenango loam: Cl
- Gloucester stony loam: Gst
- Chenango sandy loam: Csa
- Gloucester stony sandy loam: Gs
- Chenango fine sandy loam: Cf
- Gloucester sandy loam: Gsl
- Chenango silt loam: Ch
- Gravelly phase: Gsl
- Lackawanna loam: Ll
- Wallpack stony loam: Wsl
- Lackawanna stony loam: Lst
- Wallpack shale loam: Wsh
- Culvers loam: C
- Wallpack fine sandy loam: Wf
- Culvers stony loam: Cst
- Wallpack silt loam: Wsl
- Fox gravelly loam: FG
- Heavy subsoil phase: Wsl
- Genesee loam: G
- Hoosic loam: Hl
- Papakating silt loam: Psl
- Hoosic gravelly loam: Hg
- Wallkill silty clay loam: Wk
- Hoosic sandy loam: Hsl
- Wasteland: W
- Muck: Mu
- Rough stony land: Rsl
- Meadow: M
- Rock outcrop: R
- Swampy areas

J. E. Lapham, Inspector in Charge Northern Division
Soils surveyed by H. Jennings, of the U.S. Department of Agriculture, and I. L. Owen, I.V. Stone, and W. B. Robbers of the New Jersey State Agricultural Experiment Station

BASE MAP FROM THE ATLAS SHEETS OF THE NEW JERSEY GEOLOGICAL SURVEY

Scale 1 Mile to an inch.
Miles
Yards
Meters
Contour interval 20 feet

Field Operations
Bureau of Soils
1911